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VOLUME XIV

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1914–1915

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NEW SERIES, No. 105. (VOL. XIV.) MARCH, 1914.

QUARTERLY PUBLICATIONS OF THE AMERICAN STATISTICAL ASSOCIATION.

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Officers of the American Statistical Association.

ORGANIZED NOVEMBER 27, 1839.

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AMERICAN
STATISTICAL ASSOCIATION.

NEW SERIES, No. 105. MARCH, 1914.

THE SEVENTY-FIFTH ANNIVERSARY CELEBRATION OF THE AMERICAN STATISTICAL ASSOCIATION.

The annual meeting of the American Statistical Association, held in Boston, February 13 and 14, 1914, took the form of a special celebration of the seventy-fifth anniversary of the organization of the Association in this city in 1839. The Association was founded by serious-minded men for a serious purpose, and this celebration was so planned and carried out as to fittingly exemplify the ideals of the founders and the well-established traditions of the Association.

Three sessions were devoted to the discussion of the progress of statistical science and statistical achievement during the period covered by the existence of the Association, and of the present status of such work, particularly in the United States. It would be impossible to adequately present in a brief summary the substance of this discussion or even the conclusions of the authors of the several papers. Some of these papers appear in this number of the QUARTERLY PUBLICATIONS and the rest will be printed in subsequent numbers or in the Memorial Volume* which is to be prepared in commemoration of this event in the history of the Association.

It was a source of gratification to the members of the Association to learn that the Association is not only almost as old as the science of statistics, but that it has had no little part in shaping and promoting the wonderful development of statistical work during that past three quarters of a century.

The meetings were not devoted exclusively to business and serious discussion. Considerable opportunity was afforded for social intercourse among the members and guests at the headquarters, in the Hotel Copley-Plaza, and the final session took the form of a banquet at the Algonquin Club, which was

*See Quarterly Publications of the American Statistical Association, Vol. XIII, p. 559.

attended by a larger number of ladies than had been present at the other sessions.

The extent of the interest aroused by this meeting is manifested in the unusually large attendance of members. There were over one hundred present, many of them coming from a considerable distance. In addition to members the following official representatives of other associations and institutions of learning were in attendance:

F. H. Giddings, American Sociological Society; Columbia University.

F. S. Baldwin, Boston University.

A. W. Whitney, University of California.

F. H. Hankins, Clark University and College.

Frank Sanborn, University of the State of New York.

W. F. Willcox, Cornell University; Royal Statistical Society of England.

D. R. Dewey, Massachusetts Institute of Technology; American Economic Association.

H. Lefavour, Simmons College.

Irving Fisher, Yale University.

W. M. Steuart, United States Department of Commerce.

J. M. Motley, Brown University.

R. S. McCrea, University of Pennsylvania.

F. A. Woods, American Association for the Advancement of Science.

C. H. Verrill, United States Department of Labor.

Herbert B. Dow, American Actuarial Society.

E. S. Macphail, Canadian Census Office.

Ernest H. Godfrey, Canadian Census Office.

Edmund E. Day, Harvard University.

M. L. de Pulligny and M. H. Bunle, Statistical Society of Paris.

Selskar M. Gunn, American Public Health Association.

F. L. Hoffman, American Academy of Political and Social Science; *Deutsche Statistische Gesellschaft.*

Worthington C. Ford, American Historical Society.

Henry C. Metcalf, Tufts College.

Special greetings were received from the following:

The Manchester Statistical Society (founded in 1833), through its president, Theodore Gregory.

The Royal Statistical Society, which had delegated Professor Willcox, one of the fellows, to represent it.

The Statistical Society of Paris, through its secretary, M. Borriol, and which was happily represented by M. Pulligny and M. Bunle.

The *Deutsche Statistische Gesellschaft,* through its secretary, Dr. Würzburger. Being unable to send a special delegate it fitly chose Mr. F. L. Hoffman to represent it.

The Central Statistical Commission of Austria, through its president, Dr. Robert Meyer, who appointed Professor Schumpeter of Vienna, who is now in this country, to represent it. Unfortunately Professor Schumpeter was on his way to the Pacific Coast, but sent flattering messages.

Luigi Bodio, Rome, Italy.

Julius de Vargha, former Director of the Central Statistical Office of Hungary and now Secretary of State.

Professor Julius Mandello, also of Hungary, an honorary member.

Professor C. A. Verijn Stuart, President of the Central Statistical Commission of the Netherlands, on behalf of the Dutch Society for Economics and Statistics.

Verein für Geographie und Statistik, Frankfort am Main, Professor Dr. Deckert, president.

Professor D. Landsberg, President Verband *Deutscher Stadtestatistiker.*

The Board of Directors of the Association elected the following honorary members at a special meeting held on February 14:

AUSTRALIA.

George Handley Knibbs, C. M. G., F. R. A. S., F. S. S., Commonwealth Statistician for Australia.

AUSTRIA.

Dr. Robert Meyer, Privy Councillor; former Minister of Finance; President of the Imperial and Royal Central Statistical Commission.

BELGIUM.

Professor Emile Waxweiler, Director of the Solvay Sociological Institute, Brussels; Professor of Statistics, Economics and Sociology at the University of Brussels; Member of the Royal Academy of Brussels.

CANADA.

Dr. Archibald Blue, Chief Officer of the Census and Statistics Office.

DENMARK.

Professor Harald Ludvig, Westergaard, Professor of Political Economy and Statistics at the University of Copenhagen; author of important books on the theory of statistics and on the principles of mortality and morbidity statistics.

ENGLAND.

Sir J. Athelstane Baines, C. S. I., past President of the Royal Statistical Society; former Census Commissioner under the Government of India.

Major P. J. Craigie, C. B., past President of the Royal Statistical Society; former Secretary-General of the International Statistical Institute; former Director of Statistical Intelligence in the Board of Agriculture.

Arthur Newsholme, M. D., C. B., Medical Officer of the Local Government Board.

FRANCE.

Jacques Bertillon, M. D., former Chief of the Statistical Department of the City of Paris; Member of the Superior Council of Statistics; past President of the Statistical Institute of Paris.

M. Yves Guyot, Member of the Superior Council of Statistics; past President of the Statistical Society of Paris; Ex-minister of Public Works.

M. Lucien March, Director of the *Statistique Générale de la France;* Member of the Superior Council of Statistics; past President of the Statistical Society of Paris.

GERMANY.

Dr. Georg von Mayr, Ex-under Secretary of State for Alsace-Lorraine; former Director of the Royal Statistical Bureau of Bavaria; Honorary Member of the International Statistical Institute; Professor of Statistics, Finance and Political Economy at the University of Munich; President of the *Deutsche Statistische Gesellschaft.*

Dr. Wilhelm Lexis, Professor of Economics and Statistics at the University of Göttingen; former Vice-President of the

International Statistical Institute; *Geheimer Oberregierangsrat.*

Dr. E. Delbrück, President of the Imperial Statistical Office.

HUNGARY.

Dr. Julius de Vargha, Secretary of State; former Director of the Central Statistical Office of Hungary; Member of the Hungarian Academy of Sciences.

ITALY.

Carlo Francesco Ferraris, Professor of Adminstrative Science and Law at the Royal University of Padua; Member of the Superior Council of Statistics for Italy; Ex-minister of Public Works; Member of the Italian Parliment.

Rudolph Benini, Professor of Statistics in the University of Rome; Member of the Superior Council of Statistics.

JAPAN.

Dr. Naosaburo Hanabusa, Director of the General Statistical Bureau of Japan; Vice-President of the Statistical Society of Tokyo.

NETHERLANDS.

C. A. Verijn Stuart, Professor of Political Economy and Statistics at the University; President of the Central Statistical Commission of the Netherlands; Secretary-General of the International Statistical Institute; former Director of the Central Statistical Bureau.

NORWAY.

Andere Nicolai Kiaer, former Director of the Central Statistical Bureau of Norway; Associate of the Statistical Society of Paris.

RUSSIA.

Dr. P. J. Georgievsky, President of the Central Statistical Commission; Privy Councillor.

SWEDEN.

Dr. Gustav Sundbärg, Professor of Statistics at the University of Upsala; Editor of the International Statistical Summaries.

SWITZERLAND.

Dr. Louis Guillaume, Director of the Federal Statistical Bureau; former Secretary of the International Prison Congress.

PROCEEDINGS OF THE SEVENTY-FIFTH ANNUAL MEETING OF THE AMERICAN STATISTICAL ASSOCIATION, BOSTON, MASS., FEBRUARY 13–14, 1914.

The seventy-fifth annual meeting of the American Statistical Association was held in Boston, Mass., February 13–14, 1914. The following program was carried out with some slight changes:

PROGRAM.

First Session, Friday, February 13, at 8 p. m.

1. President's Address, John Koren.
2. The Development and Progress in Statistics during Seventy-five Years, S. N. D. North.
3. Brief Greetings by Invited Guests.

Second Session, Saturday, February 14, at 10 a. m.

1. Coöperation between Academic and Official Statistics, Walter F. Willcox.
2. The Service of Statistics:
   a. To Economics, David Kinley.
   b. To Sociology, F. H. Giddings.
   c. To History, C. H. Hull.
   d. To Biology, Raymond Pearl.

Third Session, Saturday, February 14, at 2.30 p. m.

1. Economic and Social Progress of the United States during Seventy-five Years, Frederick L. Hoffman.
2. The Present Status of Statistical Work and How it Needs to be Developed in the Service:
   a. Of the Federal Government, W. S. Rossiter.
   b. Of States, Adna F. Weber.
   c. Of the Municipalities, F. Spencer Baldwin.
   d. Of Private Societies and Organizations, W. S. Gifford.
3. Annual Business meeting.

Saturday at 7.00 p. m., Banquet at the Algonquin Club, 217 Commonwealth Avenue.

MINUTES.

The meeting was called to order at 4.30 p. m., by President John Koren.

The reports of officers were then called for.

Secretary's Report.

Mr. President and Members of the Association:

I have the following to report in regard to the condition of the Association:

Membership December 28, 1912, date of last annual meeting		634
New members added		93
Deaths during the year	9	
Resignations	31	
Dropped	1	
Total deductions		41
Present membership		686
Net gain		52
Beside members we have:		
Subscribers (mostly libraries)		187
Domestic Exchanges		37
Foreign Exchanges		115
Total mailing list		1,025

The following members have died during the year: John S. Billings, Henry T. Buffington, Robert C. Chapin, George G. Crocker, S. W. Dike, Henry W. Hoole, James MacAlister, H. J. Messenger, and J. B. Sewall.

Four regular numbers of the Quarterly Publications have been issued during the year, containing an aggregate of 329 pages, or an average of 82 pages per number. In addition to these, No. 4, which has been out of print and for which there has been a constant demand, was reprinted. This added about $150 to the cost of printing for the year, but this expenditure has already been justified by the increased sales of early volumes and complete sets.

Four quarterly meetings have been held during the year, as follows: At the Yale Club, New York City, April 17, 1913; at the Ebbitt House, Washington, D. C., April 18, 1913; at the Yale Club, New York City, December 4, 1913; and at the Hotel Westminster, Boston, December 9, 1913. Each of these meetings took the form of a dinner, following which there was a discussion of some single topic. All of these meetings were well attended, and it seems well worth while to continue the

practice of holding such meetings in these three cities, in each of which there are at least one hundred members of the Association.

Respectfully submitted,

CARROLL W. DOTEN,

Secretary.

On motion it was voted to accept the report of the secretary and to make it a part of the published proceedings of the meeting.

TREASURER'S REPORT.

December 24, 1912, to January 1, 1914.

RECEIPTS.

Membership Dues	$962.42	
Sales and Subscriptions	459.95	
Dividends and Interest	198.97	
Balance on hand, December 24, 1912	302.68	
		$1,924.02

EXPENDITURES.

Printing	$872.64	
Postage	74.90	
Salaries and clerical service	409.33	
Expenses	25.20	
	$1,382.07	
Balance on hand, January 1, 1914	541.95	
		$1,924.02

ASSETS.

17 shares B. & A. R. R. Stock @ 188 per share.

S. B. PEARMAIN,

Treasurer.

AUDITORS' REPORT.

We have audited the accounts of the treasurer of the American Statistical Association, for the year December 24, 1912, to January 1, 1914, and counted the securities in his possession. We find the accounts accurately stated and the expenditures properly vouched.

Respectfully submitted,

EDWARD M. HARTWELL,

LEROY D. PEAVEY.

Auditing Committee.

On motion both reports were accepted and ordered on file.

The Committee on Nominations, consisting of Davis R. Dewey, William M. Steuart, and Robert E. Chaddock, reported the following list of officers for the ensuing year: President, John Koren; Vice-Presidents, Charles P. Neill, Edward B. Phelps, Charles F. Gettemy, Charles H. Verrill, Joseph A. Hill; Librarian, Horace G. Wadlin; Treasurer, S. B. Pearmain; Secretary, Carroll W. Doten; Assistant Secretaries, Emil P. Secker, Robert E. Chaddock; Counsellors, S. N. D. North, Frederick L. Hoffman, Walter F. Willcox; Editor, William B. Bailey; Associate Editors, Frederick S. Crum, Warren M. Persons, Julius H. Parmelee, Louis I. Dublin; Committee on Finance, Edwin W. DeLeon, Miles M. Dawson, S. B. Pearmain; Committee on Library, Roger W. Babson, Edmund E. Day, Horace L. Wheeler.

It was voted on motion to favor the movement for the transfer of the function of recording vital statistics in Massachusetts from the Secretary of State to the State Board of Health.

Voted that a delegate be appointed by the president to meet with representatives of the American Society of Mechanical Engineers, to consider standards of graphic presentation of statistics. Leonard P. Ayres was appointed as such delegate

The following resolutions were read and adopted:

WHEREAS, there is great dearth of statistics relating to mortality and disability, due to occupational causes, in the United States;

WHEREAS, such statistics are urgently needed in the immediate present and will be yet more sorely needed in the near future, in order to enable problems of workmen's compensation to be dealt with adequately and economically, and in order to introduce and enforce better means of prevention;

WHEREAS, these statistics would be of the greatest interest and value to members of Congress, heads of departments charged with the enforcement of labor, prevention, or workmen's compensation laws, employers of labor in computing costs and in prevention of accidents, and to all the people;

WHEREAS, for the first time through registration of deaths among a population exceeding one half of the entire population of the nation, and through the taking of a census with due regard to occupation, covering in a separable manner the same population, thus for the first time enabling mortality tables according to occupation to be deduced;

WHEREAS, the special agents, appointed to advise the director of the census what portions of the work projected by his bureau must be dropped because of reduced appropriation therefor, have reported in favor of drop-

ping this investigation, estimated to cost not more than $50,000, because the last to be added to the list in point of time;

WHEREAS, a large amount of money has already been expended upon this compilation in the collection of data, arranging the same, the complete analysis of the deaths by causes, by the sub-bureau of vital statistics and an expensive study of occupational classification, the benefit of all of which will be lost and this invaluable information, now so urgently required, be rendered unavailable until at least after another census will have been taken, unless something now be done; and

WHEREAS, there is now pending in the Senate a resolution offered by Hon. Morris Sheppard, Senator from Texas, calling upon the Commissioner of Labor Statistics to supply for the information of the Senate statistics concerning mortality and disability due to occupation, and the Commissioner of Labor Statistics has reported his willingness to undertake this task, with the coöperation of the Bureau of the Census and of others who have offered data and services; now, therefore, be it

Resolved, That the American Statistical Association, regularly assembled in the City of Boston at this, its seventy-fifth anniversary meeting, deplores and protests against the abandonment, by reason of the short-sighted parsimony of Congress, of the task of ascertaining from all the data available at this time all that can be learned therefrom concerning mortality and disability due to occupation; and further, be it

Resolved, That this Association urges upon the Senate of the United States, as a thing imperatively necessary at this time, the passage of the resolution offered by Senator Sheppard, to the end that information upon these important subjects may be made available as quickly as possible for guidance of the Senators in their consideration of measures for workmen's compensation, public health and prevention of occupational accident and disease, and for the general information of all in authority and of the people of the United States.

It was voted that the president appoint a committee of three members to consider amendments to the constitution of the Association, looking toward the wider participation of members in the nomination and election of officers and in other important matters to come before the Association.

The president appointed the following as such committee: Julius H. Parmelee, Frederick S. Crum, and Carroll W. Doten.

It was moved and carried that the question of further amendments to the constitution regarding fellows be referred to the Board of Directors, to be reported upon at or before the next annual meeting.

The president appointed Leroy D. Peavey and Roswell F. Phelps as an auditing committee for the coming year.

ROBERT E. CHADDOCK,
Acting Secretary.

THE SERVICE OF STATISTICS TO ECONOMICS.*

By David Kinley, PhD., LL.D., *Director of the Courses in Business Organization, University of Illinois.*

On an occasion like this the temptation is great to use the opportunity and privilege of speaking, in extending congratulations to the organization in whose honor this company is gathered, on the long and distinguished service it has rendered to the science for the promotion of which it was founded. Though adding my word of testimony, I must leave to others the more extended presentation of the appreciation of the scientific world of the great service of the American Statistical Association.

A second temptation, to which one is subject on an occasion like this, is to use the few minutes at his disposal in reviewing the work that has been done in the particular field of which he speaks. If I were to do that I would be able, indeed, to paint an encouraging picture of progress in the application of statistics to economic science, and to pay a high tribute to the long list of names distinguished in this particular field of study. This opportunity, however, like the first, I must eschew. It is impossible in twenty minutes to present even a general survey of the history and application of statistics to economics with any hope that it would be intelligently followed even by an audience as appreciative and intellectually keen as a Boston audience is reputed to be.

Nor can I pause, much as I might like to do so, to discuss the nature and limitation of the statistical method in economics, or any phase of its technique. All these things, I must take it for granted, are so well known to you that their discussion would be unnecessary even had I the time to enter upon it. For these reasons I have chosen to confine my remarks in the main to a consideration of the nature of the economic problems which I think can be successfully dealt with by statistical methods, and to point out certain lines of investigation into which I think the statistical method can be pushed in the future with more success than hitherto.

* Paper presented at the seventy-fifth anniversary meeting of the American Statistical Association, Boston, Mass., February 14, 1914.

Statistics began as a social science, or, if you please, the statistical method found its first application in the study of social data. For a long time but little was done or could be done beyond the mere presentation in statistical form of some simple and easily gotten facts of economic life. Consequently, the high hopes with which many students welcomed the introduction of statistics into economic study became dim as the years passed by, and gradually there grew up a feeling that, after all, but little was to be hoped in the way of contributions to economic theory, at any rate, by the statistical method. Of late years the flame of hope has been kindled again, and there is some reason to think that the theoretical discussions carried on a generation ago on philosophical premises may find a new foundation and emerge in more accurate form on the basis of the statistical discussions now going on.

The principal service which, in the past, statistics have rendered and which, therefore, many people have come to think is its only possible service, to economics, is to afford an accurate form of summary statement of economic facts and changes. In other words, statistics enable us to present pictures of existing conditions showing wherein they are defective, according to some accepted standard, and so enable us to make suggestions of remedies for the defects. From this point of view they are simply a statement of facts of interest and importance presented in such a way as to enable the eye and mind to grasp them as a whole more readily and clearly. Their utility, therefore, lies in their adaptability to presentation in a succinct form. If we could present the same facts in the shape of a mathematical formula even a greater advantage would accrue.

In this view the statistical form of presentation is not considered as making any suggestion of relationships in the group or of possible remedies for defects. While I am one of those who think that this is not the whole service of statistics but only the first of a series of great services, and believe that we shall yet found many if not all of our economic theories on statistical data, yet it is true that until now the main result of the gathering of economic statistics has been to enable us to state more clearly the nature of the phenomena which we were studying.

This service of statistics can be readily illustrated by the records of unemployment which have been so generously gathered in the past ten or twenty years. The tabulation of employment or unemployment by trades, for example, reveals the character and extent of disturbances due to seasonal causes, to fashion and other irregular causes, to the character of the industry, and, therefore, throws light upon the obstacles which it is necessary for us to remove in order to reduce unemployment and make employment more continuous. The statistics themselves furnish no suggestion as to the methods of accomplishing this purpose. They simply indicate where and how the remedy, if one can be found, is to be employed. The remedy must be sought in our notions or standards of welfare outside of the statistics themselves. We cannot be sure that the facts presented in the statistical tables, showing for example seasonal unemployment, disclose a causal relation between seasons and unemployment. This conclusion must be reached on other grounds. To put the matter in another way, if our statistics show that at certain recurrent seasons of the year there is a certain amount of unemployment in certain industries, we must inquire into the nature of the industries before we can conclude that the unemployment is due to seasonal causes. To be sure, if we have a considerable series of such statistics on the same industries, and if the same facts are evident at recurrent periods, there is established a strong probability of a causal relation; but a single table of this kind at a given time cannot show this for us, although it may be of great value in enabling us to apply remedies to evil conditions existent at the time. Such remedies must, of course, under these circumstances, be purely empirical and tentative. In the case of the figures of unemployment in a series of tables showing the distribution of labor in the same industries in corresponding seasons, it may be that they will teach us the necessity and perhaps the way of distributing labor and readjusting industries. At any rate they will indicate what to prepare for in particular seasons in the way of extending help to those out of work. In short, the statistics indicate special problems which need attention and solution, or conditions needing specific treatment at the time.

The second service of statistics is to develop relationships of facts within particular groups of data, and lay bases for empirical laws. This service can be rendered to economics by statistics only if the statistics are so numerous that we can be reasonably sure that the facts which they present are representative of the group with which they deal, and so reflect the character of the group as a whole. Moreover, not only must they be thus representative on a particular occasion, but they must be so through a series of occasions. One of the readiest illustrations of what I have in mind is found in the well-known empirical formula sometimes known as Engel's law of expenditure among Prussian families. After investigating a great many budgets of expenditure of Prussian working-men's families, Engel came to the conclusion that certain definite proportions of expenditure of the total income ran through these budgets in a general way. For example, he found that a certain proportion of the total income of the average family went for rent; another somewhat definite proportion for food and shelter, and so on. Now, of course, no one has ever claimed that these proportions were fixed, or that they would be the same in another country, in another social class, or in the same social class at another time. The so-called law, in other words, is a purely empirical formula. It states in ordinary language relationships found to exist in a group of statistical data of a certain character, concerning a certain class, at a certain time, and under certain conditions. The conclusions were of great value, however, not only for purposes of economic description and history, but for showing the condition of the classes with whom they dealt, and revealing the points at which experiments must be made for possible improvement. It is possible to lay down a good many such empirical or positivistic laws for definite economic groups from the statistics already in our possession. Agricultural returns showing relatively decreasing yields for added capital and labor give us the empirical formula sometimes known as the law of agricultural diminishing returns. This particular formula has never been put in so definite arithmetical shape as Engel's law has sometimes been put, yet I can see that it would be possible on a limited area and under certain conditions of tillage to lay down an approximate arithmetically cor-

rect statement of the law under these conditions. Gregory King's famous attempt to establish an arithmetical relation between the changes in the price of wheat and changes in the annual crop is another illustration in kind. Formulas of relationship or empirical laws of this kind could be reasonably drawn only from statistics dealing with small statistical areas.

In the next place, economic statistics enable us to determine the direction or continuity of movement of the group with which they deal. When Agassiz long ago said that, in the biological sciences, "It is the comparative that is significant," he made a statement of equal importance for the statistics of economics. The statistical data must be comparable at different dates, so that a line of continuous movement, if it exists, may be traced through them if they are to serve any purpose other than that of satisfying curiosity, or, if you prefer, intelligent interest.

This service is closely connected with the second service, which I have just described, or that of enabling us to lay down what may be called positivistic or empirical laws of economics. Proper tables of statistics, wages, prices, expenditures, exports and imports, etc., show changes in welfare, indicating progress or retrogression. The important thing in such a series of statistical tables is the continuity of relationships within the group. They show economic movement. In so doing statistics have entered the field of dynamic economics. Such tables at the same time reveal movement and also suggest the nature of the movement and possible explanations of it. In other words we may find in the statistical tables themselves suggestions of the causal relationship of the phenomena presented, so that this service differs materially from that rendered by the kind of tables mentioned in the first instance. For example, tables of wages and prices collected at successive periods enable us not only to compare the condition of the working classes and the prosperity of industries, but may suggest causes or explanations of the changes which the tables reflect. In doing the first they form a basis for economic history. Rogers's History of Agricultural Prices, based on statistical data, and the work of Tooke and Newmarch in their History of Prices illustrate this service. Rogers's work presents figures showing the course of the wages of agricultural labor in England

through a long period. The figures indicate not only changes in the condition of the agricultural laborer, but suggest probable explanations of these changes at different times. For example, when we find in such tables marked changes in the money income of agricultural laborers side by side with corresponding changes in other sources of income through the loss, for instance, of access to common pasturage, turbage, and similar rights, it is not difficult to see a causal connection in the figures themselves, aside from knowledge derived from other sources of political and social changes. To be sure, in a case like this, whatever conclusions we draw can never be entirely safe without being checked by knowledge from outside sources; but the point I am urging is that in the absence of such knowledge the figures themselves serve a good purpose in throwing some light on the changes that are going on.

Still again, economic statistics furnish a basis for legislation and administration. This is a service on which I need not enlarge. Governments the world over are recognizing its importance. The appointment of our own tariff commission is a recognition of this service. The industry with which governments collect and collate tax returns, the insistence of our interstate commerce commission upon proper statistical returns from railroads, and a large number of other illustrations will occur to every one. It is worth while mentioning specifically the latest proposal in this direction, namely, to gather statistics of industry of such character and in such form as to determine what constitutes a unit of maximum efficiency in an industry of a particular kind.

In an inquiry of this kind it would be necessary first to settle from what point of view efficiency is to be defined. Probably it would be efficiency in the sense of determining what is the largest amount of capital that could be employed in a given industry without endangering public welfare by putting industrial control in the hands of the owners of the capital, and at the same time promote public welfare by turning out product at lower costs than could be obtained with less capital, and still more to establish working conditions which would be better than those that could be established in an organization with a less capital. Personally, I believe the inquiry is a practicable one. Certain constants would have to

be assumed and then the problem, statistically and mathematically, would amount to a collection of data to be used in the solution of a problem of maxima and minima.

Another service of statistics to economics is found in the possibility of tracing the effects of economic legislation. Beyond question this is difficult to do because of the multiplicity of influences in any economic operation. Moreover, pretty nearly every law produces results entirely unexpected by its framers and not infrequently of a character opposite to that which is aimed at. Nevertheless, in a general way, and sometimes in particular ways, it is possible through statistical data to trace the effects of particular laws. Inferences based upon such evidence appeal far more strongly to the public mind than do conclusions of the same character based on a priori consideration. The public brushes aside with impatience the opinions of critics of the modern system of workmen's compensation, accident and benefit insurance, and similar legislation, on the ground that these criticisms are *a priori*, theoretical, not based on facts, but on the critics' guesses about human need. When, however, a German authority publishes figures showing that the period of recuperation from accidents and illness under the influence of such legislation has been increased far beyond the normal period required for such recovery, the public is compelled to give attention to the situation.

All sorts of statements have been made about the effects of the reduction of our own tariff in recent months. While it is not true that one man's statement about such matters is as good as that of another, it is true that, if by the collection and proper presentation of statistics after a time we can show in actual figures what some of the results are, attention at least will be arrested. It should be possible to show the extent to which the industries thus less protected are disturbed, whether they have been obliged to curtail their activity, to dismiss some of their workmen, or have met the new situation by greater efficiency, reduced costs, or smaller profits. It should be possible, and certainly interesting, to trace the effect of this legislation on wages, prices and the cost of living; and to show, by figures of industrial establishments, whether the law has caused any new distribution of industry. Certainly tables of

exports and imports ought to throw some light on this last question; for if it be true, as alleged, that we are importing more of the goods which have been in a measure deprived of their former protection, we must pay for them by exporting more goods of some other kind, and it ought to be possible to find statistics which will show whether industries of other kinds have expanded, or whether new industries have been established to furnish the products necessary to meet these larger foreign importations.

But little has been done in the application of statistics to the discovery of economic theory although much has been done in the use of statistics in the way of elucidation. The field, however, is one of great importance, concerning the feasibility of which there still is and always has been a good deal of skepticism. Is it possible to discover a law of interest, a law of wages, or any other general law from the statistics of the subject? By general theory I mean a general expression of the determining forces of a group of economic phenomena, such as wages, or interest, or prices, or the whole field of distribution. Of course, general theory cannot represent accurately "the life and movement of the economic world." It serves to show the general lines of probable truth. In the language of mathematics, a general theory derived from statistical data must be based on averages, and, therefore, must represent a type or limited case. It is the limit towards which actual cases tend indefinitely to approach. This must be so because such a theory must be a law of economic statics. It is conceivable, indeed, that even a dynamic law may be in time discovered from statistical data, but we are yet far from that possibility. However, the pure theory of economic statics has reached the stage where, as Prof. H. L. Moore shows, it can be put in mathematical or symbolic form as a type of the things which that explains.

A use of statistics for the purpose of developing a general theory is possible only by the use of proper mathematical methods. The data must be handled according to mathematical laws. Fortunately, as economic statistics have been developed the mathematical instrument or method for handling groups or masses of data has also been perfected. The calculus of phenomena in masses has been much developed,

especially in the biological sciences in the past ten or fifteen years, and the tool of which Pearson and his colleagues have made such powerful and successful use lies ready to the hand of the student of economic facts.

Since the phenomena are numerous and mutually dependent they can be represented statistically and mathematically only if the statistics are reducible to a series of simultaneous equations, as numerous as the unknown quantities under consideration. It is a mistake to suppose that a series of figures on any one of the subjects of general theory can be treated as a simple equation, or represented graphically as a linear movement. For in dealing with general theory we must use what I have described as the complex homogeneous unit. The data in such a unit are more or less numerous and conflicting. If, however, we are reasonably sure that the character and degree of conflict is approximately constant through a series of successive units, so that, so to speak, the antagonistic elements neutralize one another, so far as concerns the main purpose of our inquiry such units can be used as successfully and logically as if they were homogeneous, in the simple sense of being uniform in character or makeup. One of the most successful illustrations of the use of statistics for the establishment of a general theory is Prof. H. L. Moore's admirable statistical treatment of the law of wages, which established statistically the specific productivity theory, and incidentally checked the deductive processes whereby that theory was reached in the first place.

One hestitates to use an illustration from his own work, yet with apologies for doing so I may be permitted to illustrate what I mean by a complex homogenous unit and the possible deduction of the general theory from statistical data, by a reference to what I laid down some years ago as the main features of what some of my colleagues have been kind enough to call a theory of credit. I used for my purpose the statistics which I obtained in connection with the investigation into the use of credit instruments in business payments, first in 1895 and later in 1903. It is commonly stated that there is no necessary connection between increasing population and volume of business, or, therefore, volume of payments or use of credit facilities. For a very different amount of business may be done

on the basis of the same amount of money and by very different numbers of people. Yet if we can get a complex homogeneous unit, or one in which the other conflicting elements are numerous enough to justify us in supposing that they neutralize one another in the main, while the unit as a whole acts uniformly, I think we may make bold to try to establish some relation between population growth and the amount of money needed and the amount of credit built upon it, and by inference what I have called the static distribution of the precious metals. Not to go into details I calculated the percentage of credit payments for population groups at intervals, and plotted the irregular line which represented it. Smoothing out this line and making it into a better curve by one of the well-known devices, I finally secured what I regarded as a limiting curve from the character of which I made certain inferences as follows:

First, that the proportion of credit increases gradually with population in a country like ours, and under our conditions.

Second, that it increases with more or less regular periodical fluctuations, giving us a series of maxima and minima.

Third, that its rate of increase tends to become less rapid as the volume of population and, therefore, the volume of business grows.

These conclusions I rather jumped at by what may be called a bold imagination from the indications which the curve showed rather than proved by exact induction. When they were suggested to my mind I tried to see whether they could be established deductively, and succeeded, I think, in establishing them by this logical process. Indeed, so much more sure did I feel of the logical argument on account of the paucity of my data, that when I presented the subject some years ago I ignored the statistical presentation altogether, simply because it was so novel at that time and involved so many of what critics would be likely to call guesses, that I felt that the other presentation would appeal to my colleagues more successfully. It is my belief that similar use of carefully collected statistics will yet give us the ground on which we shall be able to formulate some of the general economic theories for which we are groping, and afford formulas wherewith to solve many problems of our industrial life.

THE SERVICE OF STATISTICS TO SOCIOLOGY*

By Franklin H. Giddings, Ph.D., LL.D.,
Professor of Sociology, Columbia University.

Statistics have been of relatively limited service to sociology hitherto because of the quantitative limitations of sociological data.

In economics we have not only frequencies of Sort or Kind, but also abundant frequencies of Size. Prices of commodities, wage rates, interest rates, rents, dividends, and tax rates are measures of size as well as categories of kind. In sociology, while frequencies of size are by no means wanting, as witness, birth and death rates, marriage and divorce rates, by far the greater proportion of our numerical data are frequencies of sort or kind. For example, respective numbers of the different nationalities entering the United States through our ports of immigration, numbers of the foreign and the native born, numbers of the literate and the illiterate, numbers of adherents to the different religious creeds, numbers of persons engaged in various occupations, numbers of the delinquent and the dependent, and so on are frequencies of sort.

Practically all of our statistical operations have been developed through comparisons of size and analyses of size frequencies. Normal frequency distribution, mean square deviation, the coefficient of variability, probable error, and the coefficient of correlation are measures inherent in items of size rather than in items of sort.

Perhaps it has been too hastily assumed that statistical results obtainable through the use of these measures can never be obtained in any other way; and it may be worth while to indicate certain possibilities of statistical measurement that lie in frequencies of sort which, if systematically applied to our large collections of data in census and other reports, might add much to our scientific knowledge of social relations.

Let us then for a moment examine certain statistical measures that may be derived from the mere inequality of sort frequencies; such inequality, for example, as is presented by the num-

* Paper read at the seventy-fifth anniversary meeting of the American Statistical Association, Boston, Mass., February 14, 1914.

bers of foreign-born Irish, foreign-born Germans, foreign-born French Canadians, foreign-born Italians, and so on, in the population of any one of our commonwealths.

The inequality of two numbers a and b is measured by the difference $a-b$. The total inequality of n numbers, one to another, is the sum of the differences found when each number is subtracted from every other number, and each difference is counted once, or:

Total inequality of n numbers $= (a-b)+(a-c) + (a-d) + \ldots\ldots + (a-n) + (b-c) + (b-d) + \ldots\ldots + (b-n) + (c-d) + \ldots\ldots + (c-n) + \ldots\ldots + (d-n)$.

If the smallest of n numbers be subtracted from the largest, the difference, $m-s$ is the *range* of inequality. It is the quantity of reference from which a measure of tendency to inequality among given numbers—or frequencies—may be derived.

If each lesser frequency in turn be subtracted from a maximum frequency the differences will all be positive. Their sum is the positive inequality of the frequencies in relation to the largest frequency among them, and this, divided by the number of frequencies, is the mean positive inequality.

If each greater frequency in turn be subtracted from a minimum frequency the differences will all be negative. Their sum is the negative inequality of the frequencies in relation to the smallest frequency among them, and this, divided by the number of frequencies, is the mean negative inequality.

If the ascending or descending steps of arrayed frequencies are equal, the positive and negative inequalities, as above defined, are equal. The mean inequality then is equal to one half of the difference between the maximum and the minimum frequency, or to one half of the range of inequality.

If the steps of arrayed frequencies are unequal, the positive inequality will be greater or less than the negative inequality, but the mean of the arithmetical values of the positive and negative averages will equal as before one half of the range of inequality.

The mean inequality of frequencies, of which the positive and the negative inequalities are equal, may be called *iota*, ι. The mean positive inequality of frequencies may then be expressed as ι_1, and the mean negative inequality may be expressed as ι_2.

If the negative inequality of frequencies is equal to their positive inequality, the strength of tendency to equality among them may be described as equal to the strength of tendency among them towards inequality.

If the negative and the positive inequalities of frequencies are unequal, $\iota - \iota_1$ equals $\iota - \iota_2$, but the signs of these differences are opposite. If $\iota - \iota_1$ is positive, it measures strength of tendency towards equality; if negative, it measures strength of tendency towards inequality. If, $\iota - \iota_2$ is negative, it measures strength of tendency towards equality; if positive, it measures strength of tendency towards inequality.

If the negative and the positive inequalities of frequencies are equal $\frac{\iota}{\Sigma f}$ is a coefficient of inequality; if they are approximately equal it is an approximate coefficient of inequality.

In any case, $\frac{\iota - \iota_1}{\Sigma f}$, or $\frac{\iota - \iota_2}{\Sigma f}$ is a precise coefficient of strength of tendency towards equality or towards inequality, according to sign.

These relations stand out sharply in graphic presentation.

If the positive and the negative inequalities of frequencies are equal, the frequencies, when plotted as equi-distant ordinates arrayed, will make a figure that may be bounded at the top by a straight slant line.

If the positive inequality of frequencies exceeds the negative inequality, the frequencies, when plotted as equi-distant ordinates arrayed, will make a figure that may be bounded at the top by a downward curving or concave line.

If the negative inequality of frequencies exceeds the positive inequality the frequencies when plotted as equi-distant ordinates arrayed, will make a figure that may be bounded by an upward curving or convex line.

From mere frequencies of sort we can obtain also a measure of the sociologically important phenomenon of coördination, as distinguished from correlation.

Coördination is equivalence of position. For example, in botanical or in zoölogical classification genera are coördinate one with another, but are subordinate to orders as orders are to classes; species are coördinate one with another, but are subordinate to genera. In the ecclesiastical hierarchy priests are

of coördinate rank, bishops of coördinate higher rank, and archbishops of coördinate rank yet higher.

Superordinated or subordinated coördination, or the coördination of units within each rank throughout a succession of ranks, one above or one below another, is obviously a phenomenon incidental to all subclassification, creating intra-secting categories, or category within category, in descending comprehensiveness.

And when categories are intra-secting, the whole content of category B falls within category A; the whole content of category C falls within category B; and so on.

Therefore, statistically, coördination, superordinate or subordinate, is the appearance of certain same units in each of n categories.

Identity or sameness of content in each of two or more categories may be called Categorical Solidarity.

Since all units of category B, intra-secting category A, occur also in A, it is plain that in these two categories taken together there are as many unit instances of "same content" in more than one category as there are units in category B.

All units of category C, intra-secting B, occur also in B and in A. Therefore, taking the first three categories together, they present as many unit instances of "same content" in more than one category as there are units in B plus the number of units in C.

All units of category D occur also in C, in B, and in A. Therefore, in these four categories taken together there are as many unit instances of "same content" in more than one category as there are units in B, plus units in C, plus units in D.

In general, if categorical solidarity be expressed by S, a comprehensive category by K, and intra-secting categories by k_1, k_2, k_3, ... , k_n

$$S = k_1 + k_2 + k_3 + \dots + k_n$$

S, so obtained, is an amount, and it is affected by the number of categories used. The degree, or average density, of solidarity, category with category, may be obtained, therefore by dividing S by n.

If the number of units in each of n categories were the same, and if the "same content" (neither more nor less, nor different) were in each and all categories, K would equal k_1, would equal

k_2, would equal k_3, and so on. Indicating the greatest arithmetically possible solidarity of n categories by G, we of course have $G = K (n-1)$, and the greatest possible degree of solidarity of n categories is $\frac{G}{n}$.

The ratio $\frac{S}{n} : \frac{G}{n}$ or $\frac{S}{G}$ is the coefficient of solidarity for any values of K, k_1 and n.

All measures of solidarity are corresponding measures of coördination.

With these additions to our means of measurement, what are the possibilities of statistical analysis in sociology?

Any association of units presents to the observer certain aspects which admit of quantitative description by statistical methods.

These aspects are: 1, Extent; 2, Duration; 3, Strength; 4, Compositeness; 5, Form; 6, Reaction; 7, Central Point or "center of gravity" of Reaction; 8, Contingency.

The statistical examination of the extent and the duration of association is the simplest of statistical operations. It involves only completeness and accuracy of count, and accurate determinations of date.

Strength of association is resistance to dissolution or disintegration. Dissolution, or disintegration, is statistically measured by the percentage, or other proportion, of associations of a given kind that break up within a given time. Family cohesion, for example, is measured by the divorce rate.

When units of more than one sort are combined in a mixture, the compositeness thereby arising is of three degrees, which may be named respectively, Variegation, Approximate Composition, and True Composition or Heterogeneity.

Variegation is determined by two variable quantities only, namely, (1) the number of sorts in the composition, and (2) the number of items in each sort, that is, the frequencies of the sorts. Differences of magnitude among variants (*i. e.*, units of sort) and the amount of difference that exists between any one sort and any other sort (*i. e.*, inequalities of interval or step) are neglected.

When the categorical or sort frequencies of a composition

are approximately equal, the variegation may be described as uniform.

When sort frequencies are unequal, and one frequency exceeds any other, the variegation thence resulting may be described as modal.

Variegation is measured, and thereby quantitatively described, by the coefficient of tendency towards equality, or towards inequality, as the case may be, of the sort frequencies, of the composition.

Approximate composition takes account of the difference between each frequency and every other frequency in the composition. It is measured by the total inequality of the frequencies.

True composition, or heterogeneity, is the totality of differences in a composition. It includes not only frequencies of sort, and inequalities of frequencies one to another, but also all differences of item from item (in respect of dimension, weight, value, or other magnitude), and all differences of interval or step. If the data are known, heterogeneity can be computed by simple algebraic methods, which are, however, tedious.

Variegation, fortunately the simplest phase of compositeness, is a fact of significance for the organic and social sciences. Easily measured, it is a measure itself, of strength of tendency, or of influences selective or constraining.

Average deviation and standard deviation are assumed to measure the strength of a mode-making tendency, selection, or pressure acting upon variates, *i. e.*, units of size.

If, for example, poppy capsules be gathered at random from a field, and the number of stigmatic bands on each capsule be counted, and the deviation from the mean number be found to be very small, the fact is supposed to tell us that the poppies in that field, or their progenitors, have survived a severe natural selection. The smaller the standard deviation, it is inferred, the greater has been the selective or mode-making pressure.*

The same significance attaches to variegation. The coefficient of tendency to or from equality is a measure of mode-making tendency, selection or pressure for frequencies of sort, probably quite as trustworthy as the coefficient of variability for frequencies of size.

* *Vidi* Karl Pearson, "Grammar of Science," Second Edition, Chapter X, sec. 5.

If seeds of a dozen kinds be planted simultaneously and indiscriminately, but in equal numbers, in a patch of garden, which is then neglected, and six weeks later plants of the dozen kinds are flourishing in approximately equal numbers, kind for kind, we infer that no selective influence has affected them; while if plants of one or two kinds at the end of the six weeks are relatively numerous, of other kinds relatively few, and of the remaining kinds very few, we infer that selection has been rigorous.

Uniformity of variegation then, means a negligible mode-making tendency, selection, or pressure; while marked modality of sort frequencies means a mode-making tendency relatively strong, or a mode-making selection or pressure relatively severe.

The Forms of association are (1) Tangent, or exclusive, no unit of one association occurring in another association; (2) Inter-secting, certain units occurring in more than one association but no association being wholly comprised in another; and (3) Intra-secting, all the units of association B occurring in association A, all the units of association C occurring in association B, and so on in descending comprehensiveness.

Tangent association is otherwise described as "segregation" when the units of each association are similar. The simple statistical problem presented is to count the number of like units that in one or another way are placed or combined in exclusive grouping.

Intra-secting associations are a case of subclassification and coördination, superordinate or subordinate. The coefficient of coördination is a measure of intra-secting association.

The Reactions of Association are measured in units of time, of displacement, and of transformation. Promptness and persistence of reaction are measured in units of time. Degree, extent and amount of reaction are measured in units of displacement or transformation. The statistical description of these reactions involves no unusual developments of method. The difficulties that are encountered arise in the determination of data, in making the original measurements.

The Central Point of Reaction, or, using a figure of speech, the center of gravity of reaction, is that point about which all reactions, including opposing ones, are in equilibrium. If units

react in different ways and with equal power or "weight" the center of reaction is the median of the array of the units. If the several units, either individually or when massed in those squadrons of units which we call frequencies, react with different power or "weight," the center of reaction is found on that side of the median where the heavier weighting occurs. The statistical problems, accordingly, that arise in any attempt to determine the center of gravity of associational reaction are those which in statistical analysis are known as questions of weighting.

No phenomena of society are of greater interest than are the shiftings of the centers of associational reaction. Among these are the shifting of the center of gravity in politics between opposing parties, between radicals and conservatives, between classes and masses, between rationalists and the upholders of instituted authority.

The foregoing aspects of association are of interest in themselves and also, in a higher degree, because of their relation to Contingency. In determining how far association or any phase of it is quantitatively linked with any other fact, we get close to the problems of law and cause. Contingency is measured by a percentage or by the Pearsonian or other coefficient of contingency. Actual contingency when found should be compared with a theoretically probable contingency.

The contingency of any phenomenon of association may be with an extraneous fact, or with any other phenomenon of association itself. Extraneous facts collectively are the environment. The facts of association whose contingencies one with another can be determined are the aspects of association which have here been enumerated.

Among the contingencies of associational phenomena one upon another which admit of statistical determination the following are especially significant.

The strength of association may vary with extent or with duration. It may be found that cohesion increases to a certain determinable point more rapidly than extent increases, and beyond that point less rapidly. For example, as a fact of observation, large states, large towns, large families are generally more coherent than small ones. A similar relation may be found between cohesion and duration.

Again, within limits, the stability of a group may be unaffected by a mobility of its units which permits individual units to disappear from the group and other units from without to replace them. Beyond a determinable limit such mobility of units may impair group stability.

The contingencies of associational phenomena with the degrees and modalities of composition are numerous and highly important.

Within determinable limits similar reactions of associated units are contingent upon other similarities of the units. Like units, in other words, tend to react in like ways. When sorts are combined in a mixture, the units of a sort may react in ways different from the ways in which they react when not in composition. And the effects of composition upon reaction may be a consequence in part of the proportions in which sorts are combined.

Inertia or momentum of associational reaction increases in a determinable ratio with the modality of variegation, that is, as one sort tends to dominate a composition. This is a familiar fact of our social life in all its phases, from fashion to politics. Transformation goes on at an increasing rate, which may be determined, as the proportion of variants from mode increases.

And at this point contingency of associational reaction upon external fact is discovered.

Adaption to environment or circumstance increases modality. Crisis multiplies variants.

Relations of toleration, the reactions of conflict and the reactions of adjustment are notoriously contingent upon forms of association, and these contingencies in a great number of instances admit of quantitative determination. The contingency of toleration is highest when association is tangentail. Conflict is most acute when associations are intersecting. Adjustments, both of the interests of units one with another and between the opposing tendencies towards modality and towards variability, are contingent upon the development of intra-secting association.

THE SERVICE OF STATISTICS TO HISTORY.*

By Charles H. Hull, Ph. D., *Professor of American History, Cornell University.*

When your representative honored me with an invitation to take part in this discussion, I told him (what, indeed, he very well knew) that I had neither statistical experience nor statistical knowledge, and had paid but slight attention to the multifarious discussion upon the relation of history to the newer social disciplines. I could give, therefore, only my personal impressions upon the service of statistics to history, and those but provisionally. He assured me that more was not expected, and I shall not attempt more.

If the second part of this morning's program had been submitted to the founders of the American Statistical Association, it would have perplexed them sorely. Seventy-five years ago the word "economics," as a substitute for political economy (or a criticism upon it) was just making its way into the language, under the dubious aspices of those most unstatistical persons, Thomas Carlyle and Waldo Emerson. The term "biology," recently invented in Germany, had acquired, as yet, no other meaning, among those who knew it in English at all, than that of a particularly vivid form of biography—the story of a man's life as it might be talked rather than written. The hybrid "sociology" was still unbegotten. That statistics should ever serve such strange gods, might well have given the founders pause. Towards history, however, they could have turned with more confidence. Both as a word and as a subject history was, in their day, already venerable, and still respectable; and the service which statistics might render it was, to their minds, entirely clear. In the "Address put forth by the Association at the period of its first establishment,"† its spokesman, the polygraphic Professor Edwards of Andover Theological Seminary, had defined statistics as "the ascertaining and bringing together of those facts which are fitted to

*Paper read at the seventy-fifth anniversary meeting of the American Statistical Association, Boston, Mass., February 14, 1914.

†This address is printed in "Constitutions and By-Laws of the American Statistical Association, with a List of Officers, Fellows and Members. Boston: 1844."

illustrate the conditions and prospects of society.'' It followed that ''every subject in truth forms a part of statistics,'' and he naturally concluded that the labors of the Association should prove ''of inestimable value to the future historian in our own and other lands.''* This sweeping conception of statistics, quite in the temper of contemporary Germany practice, was promptly illustrated by the contributions which the Association's secretary, the Rev. Joseph B. Felt, made to the first volume of its ''Collections.'' They are, doubtless, known to many of you, and with them in mind it becomes easy to understand why Schloezer's awkwardly translated dictum† that ''statistics is history in a state of progression; statistics are history at a stand,'' should have met Professor Edwards's full approval, and, as we may infer from Colonel Wright's fondness for the neater version of the same dictum, that ''history is past statistics, statistics present history,'' have become, for a time, almost a part of the Association's creed.

Today, however, the situation is reversed. Regarding the nature and extent of the service which statistics may render to economics, to sociology, or even to biology there is, I fancy, less dispute than now exists regarding the serviceability of statistics for the purposes of the historian. To understand this change we must appreciate that ''history'' and ''statistics'' are words of variable and even ambiguous meaning, and must determine in what meanings we will take them for our present purpose.

History is an old word, blurred by careless handling. Of its many meanings two only need engage our attention. Sometimes ''history'' denotes a method, sometimes a subject. The historical method of ascertaining and presenting past events is, in a general way, familiar to us all. We readily appreciate its applicability to various subjects, and the slightest inquiry into historiography would show that the historical method has, in fact, found most diverse applications. But the interest and importance of its application to the past acts of man as a

*"Constitution," etc., pp. 13, 21, 23.

†*Ibid*, p. 13. Achenwall had written: "die Lehre von der Statsverfassung eines oder mehrerer einselnen Staten, ist die Statistik." Schloeser, who brought out a seventh enlarged edition of the Abriss (Goettingen, 1790) after Achenwall's death, inserts in the text, after "Statistik," a parenthetical explanatory "(Staatskunde)," and adds in a note: "Staatskunde [d. h. Statistik] ist eine stillstehende Statsgeschichte; so wie diese eine fortlaufende Staatskunde." Pt. 1, p. 5.

social being, his wars, arts and industries, his church and state, so far outweigh all other applications of the historical method that, as a subject, history has come to mean a reasoned narrative of man's social doings in the past, or of some of them. Like the dyer's hand, the historian's method is subdued to what it works in; and history as a method has been profoundly affected both by the antiquity of its beginnings, in an age of intellectual naivety and by the human character of the subjects which historians, following in some measure the pattern set by their predecessors, have found themselves called upon to deal with.

Statistics also has two meanings, similarly related. Statistics *is* a scientific method of wide applicability. Statistics *are* a body of facts and inferences—usually but not necessarily social—collected and interpreted according to that method. We have, then, two methods, the historical and the statistical, each, by preference applied, as it happens, to the same or similar matters, producing, the one history as a subject, the other statistics as a subject. The question remains to be answered, whether the two methods are as similar as the subjects to which they are applied.

Statistics is a newer word than history, and its method is even newer than its name. Achenwall, who invented the name in the middle of the eighteenth century, referred it to the Italian word *statista,* a statesman;* and for him, as for his follower Schloezer, statistics meant a general account of contemporary affairs, of the national fabric in widest sense, such as might be of use to a public man: Keltie's "Statesman's Year Book" is a modern English example. Robert Mills's "Statistics of South Carolina" (1826) and George White's "Statistics of Georgia" (1849) are earlier examples from American practice. The statistics of these compilers, which are also the statistics of the American Association "at the period of its first establishment," can scarcely be said to have any conscious method. Their collections were quite miscellaneous, not to say capricious. They did, indeed, show a predeliction for such data as might be expressed "in terms of number, weight and measure."† But they were by no means

*G. Achenwall. Abriss der neuesten Staatswissenschaft der heutigen vornehmsten europaischen Reiche. 1749. Einleitung.

†Sir William Petty. Political Arithmetick. 1690. Preface.

restricted to such, and seldom used them comparatively or in mass measurement.

As a method, then, statistics took its shape within the past seventy-five years, and it fell, consequently, under the influence of those instrumental devices which, as applied by all the natural sciences, have imparted to nineteenth century thought its most pronounced character. The first to apply the familiar method of the natural sciences in the new field of statistics was, perhaps, the Belgian astronomer, Quételet. Instead of concerning himself with such specific details as interested the antiquarian mind of Dr. Felt, Quételet employed the so-called Law of Large Numbers. In order to count and compare the numerous units involved, he arranged them in classes, within each of which all the units, whatever their individual diversities, were assumed to be alike for his enumerative purposes. He thus came to deal in the field of statistics, as all modern sciences do in their several fields, with typical abstractions. These are, no doubt, of great instrumental value for scientific purposes; but they can claim to find no exact counterpart in any real object. None of us has ever met "the statistical man" any more than "the economic man." They are two of the many convenient fictions of science. By the application, then, of scientific method to statistical facts, Quételet began, about the time when this Association was founded, to deduce such general social laws as seemed to him to warrant some measure of quantitative prediction about society as a whole, though he was careful to say* that they implied nothing, of necessity, as to any particular member of society. The measure of his success in what he came to call "social physics"† may have been somewhat less than he anticipated, but it was at least sufficient to make most modern statisticians his conscious or unconscious followers. Statistics had found their method, which is the general method of the natural sciences. It operates, as the sciences all do, with "laws" which apply to aggregates and averages (or other types) but not to the peculiarities of individuals. A rhombohedral crystal of oxide of silicon with trapezohedral tetartohedrism

*Recherches sur la loi de croissance, pp. 1, 2; Recherches sur la penchant au crime, pp. 2, 80.

†Physique sociale, par Ad. Quételet. Bruxelles. 1869. The first version of this book, published in 1834, he called Sur l' homme et le développement de ses facultés, ou essai de physique sociale.

is quartz,—and there you are. It may be large or small, green, purple, yellow, or pink. It is still quartz.

Following statistics, the newer social disciplines, folk-psychology, sociology, and the rest, have developed their methods under the same influence of all-conquering natural science, whose "glory fills the world with loud report." It was inevitable, then, that history, the oldest, of the social disciplines, should be called upon to mend the ancient error of its ways and by installing a modern scientific outfit of general laws and instrumental abstractions, to elevate itself to the rarefied atmosphere where true predictive science dwells. The trumpet of this summons gave no uncertain sound. Comte was confident; Buckle was cock-sure; and the modern materialistic philosophy of history threatens the bourgeois historian with the same extinction in which socialism is presently to engulf all capitalistic institutions, unless he shall straightway forsake his abhorrent, and probably venial pretense of an interest in the deeds and characters of individual men, and shall concern himself solely with the class struggle and the necessary laws of its evolution.

"Evolution," ladies and gentlemen, is the hocus-pocus of the scientific nineteenth century, just as "nature" was the hocus-pocus of the revolutionary eighteenth, and "society" promises to become the hocus-pocus of a sympathetic twentieth. Man, no doubt, will carry on, as he did through preceding centuries.

Meanwhile for the mere historian to object when others, chiefly non-historians, seek, in the sacred name of science, to apply their methods to a subject-matter which he has long dealt with in a manner lamentably unscientific, would be at once arrogant and futile. But without claiming the privilege of such folly, he may perhaps justly ask, he may even be generously allowed, to determine for himself what sort of results he, as a historian, will aim to achieve. And in so far as the methods of natural science may be incapable of reaching that sort of results, he may, for his part, abstain from employing them, not worrying himself unduly about the pains and penalties that shall in consequence be denounced upon him. If, by the use of scientific laws, results superior to his shall be produced, recognition will surely reward the achieve-

ment, and the mere historian will not be the last, let us hope, to acknowledge the new day. Meanwhile, however, we must take history as precedent and practice have shaped it, historians as in consequence they are. The serviceability of the statistical method for the past and present purpose of such persons is the subject of our immediate enquiry.

The majority of intelligent historians (if any historians may be allowed to be intelligent) would agree, I fancy, that the statistical method, being a specific type of the method of natural science, is not their proper method and cannot become their principal tool. For the ultimate units with which the historian deals are not atoms, or any sort of instrumental abstractions, whose individual differences, if any exist, may be ignored, but they are men and the deeds of men. All social phenomena are at bottom human deeds, with qualitative differences, each from each. These it is the characteristic business of the historian to study. Men and the differing deeds of men, as they present themselves for historical contemplation, seem to him too complex and too variously conditioned to be subjected to the concept of general law, as the natural sciences derive that concept from the observation of phenomena assumed to be uniform. He, for his part, can seldom find, and may never assume, that his observation of one man is as significant as his observation of another. He must rather assume the existence among men and their acts of those qualitative differences which are a fundamental fact of all organic life. This involves him in no quarrel with science. Science too freely confesses the qualitative differences of individuals. But for the purposes of science they are overlooked because they are of negligible importance. For the purposes of history, however, their importance is often the greatest.

Let me illustrate. On the first day of November in the year 1700 there died of some obscure fever at his sumptuous domicile in Madrid a married Spaniard in the thirty-ninth year of his age, whose entire adult life had been passed in public office. These, I believe, are all the data that a Körösi would need to locate the deceased in that social group which should give full weight to the statistical significance of his death. A Ranke notes, however, that the death of Charles the Bewitched, neither entirely king nor completely imbecile, brought on the

War of the Spanish Succession, and that his reluctance to make a will betimes gave opportunity for intrigues which affected the European balance of power for a century thereafter.

The historian, then, cannot rely upon the statistical method, or upon any similar method, as a means of determining the significance of a specific event. No more can he, by the use of statistical laws, or by any other method of prognosis, undertake to tell what specific incidents of historical interest must happen. If prediction be the distinguishing mark of science, the historian must confess with humility, but let us hope also with tranquility, that he is not a scientific man. His method of explanation is a retrogressive analysis. Diagnosis, not prognosis is his art. As the physician applies his skill and experience to specific cases, not to categories, and is satisfied to determine what ailment produced the symptoms that he finds in his present patient, leaving the question quite open whether certain similar symptoms, in a patient of a different temperament, are due to the same or different disease, so the historian seeks to explain his events one by one, each as an individual case for itself. Laws, deduced by inference from other cases, are for him never demonstrative, but at most hueristic. They may serve to turn his attention to a probable cause but he will not be satisfied that it is the real cause until he has examined it individually. In this the method of history differs radically from the method of statistics. The method of statistics is, by consequence, only of indirect service to the historian.

May I sum up my conclusions so far by rewriting a statement of a former President of this Association? "The student of social science," said Colonel Wright,* "uses the results of statistical enquiry because he recognizes with the German Schlosser† that 'statistics is history ever advancing,' and that if he wishes to . . . keep himself fully and thoroughly informed of progress in every direction, he must use the statistical or historical method." The position which I have tried to present this morning would be better expressed by saying instead: The historian, as a student of social phenomena,

*Practical Sociology. 5th ed. 1904. P. 8.

†This apparent confusion between Friedrich Christoph Schlosser, the historian (1776-1861), and August Ludwig Schloeser, the statistician (1735-1809), appears in Edwards's address. Wright may have taken it from him.

uses the results of statistical enquiry whenever they appear to be to his purpose, just as he might use the results of any other science; for he recognizes that if he wishes fully and thoroughly to understand past progress in every direction, he must take all knowledge to be his province. But in using the results of statistical enquiry, he employs the historical and not the statistical method.

While, however, the historian uses statistics in the same manner as he uses the facts and theories of other sciences, the circumstance that the historical and the statistical methods both find their most fruitful application in the social field, enables the statistician to furnish historical data in a measure far more ample than will, say, the astronomer, or the chemist, or the embryologist. How frequently the historian shall find statistics among his sources will depend upon the direction to be taken by future applications of the statistical method on the one hand, and of the historical method on the other.

If, for example, Professor Muensterberg, having perfected his machinery for measuring the physical reactions of individuals in moral predicaments, shall furnish the world some day, with an accurate ethical calibration of the normal American or Teuton, the future historian will be greatly concerned, I am sure, to ascertain and to compare with the type, the reaction record of the fiftieth President of the United States and the tenth Emperor of Germany. You may regard the illustration as fantastic. But principles appear in extremes. What technical or financial obstacles meanwhile impede the collection of such statistics as the historian would like to use is not for him to say; but he may selfishly hope that the American Statistical Association will presently succeed in overcoming them all.

A change or extension in the subjects of history might also increase the availability of the data of statistics as materials for the historian. Freeman, for example, has declared that "history is past politics, politics is present history,"* and Seeley says that "it is with the origin and development of states that history deals."† Their dicta voice the fashion of their day. Other times, other manners. In the era of military feudalism, historians wrote chronicles of camp and court.

*E. A. Freeman. Lectures to American Audiences. 1882. P. 20.
†Sir J. R. Seeley. The Expansion of England. 1883. P. 148.

The Reformation obliged intelligent men to become more or less theologians, and from Luther to Voltaire ecclesiastical history predominated. The revolutions of the eighteenth century in America and France brought new subjects of historical study into vogue. Not only did Guizot and Hallam trace the constitutional development of France and of England, writing always with an eye upon the political situation in which they lived, but Grote constructed a ponderous History of Greece in support of the Victorian Whigs, and Mommsen launched a learned History of Rome against Napoleon the Second.

Observing thus how, with the shifting of contemporary interests in the past, the historical method has been applied (like the statistical) to widely diverse subjects, we are prepared to find, in our own time, that the increasing pressure of social and economic problems, into which, by the help of Darwin and of Marx, we seem to see more deeply than our fathers could, must in its turn induce the application of the old method to the new stuff of social and economic history. And since the subject matter of statistics is largely social and economic, the future historian, though working still chiefly in the old way, interesting himself, among other things in the personality of a leader of invention, a captain of industry, a freebooter among insurance companies and railways, or an organizer of international peace, may make, indeed he must make larger and larger use of the statistics that are and of the statistics that are to be.

Once more may I illustrate? It was long the habit of American historians to attribute our prosperity in 1789–1792 to the adoption of the Constitution in 1788. Of recent years, however, it has been more generally believed that, for reasons altogether independent of the Philadelphia Convention, the tide of prosperity was already swelling in 1787, and that the Constitution was borne to ratification upon its rising crest. This later view is, to my mind, not only the more probable inherently, but also the better supported by evidence; and much of that evidence is statistical. It is here characteristic, and further illustrative, that the new conclusion was not the immediate result of any statistical enquiry, but rather of a general judgment, such as historians are constantly pondering in their own minds, and then weighing and testing by all

appropriate means. In this case the chief means chanced to be statistical. And if, incidentally, some historian, in dealing with it, has fallen into a trap such as field errors in statistics leave ever open for the unwary, and, for example, has assumed to measure the growth of our foreign commerce by the use of figures which register, in part at least, merely the increasing efficiency of the newspapers in recording the entries and clearances of vessels, that blunder proves, to my mind, not that the true method for history is the statistical method, but merely that the historian needs, when using statistics as a source, just as he needs when using a scarab, or book of personal reminiscences, or a party platform as a source, to exercise an alert and competent criticism. However, the extent to which, being competent, he shall use statistical sources, or some other sort of sources, must depend chiefly upon the sort of things with which, as a historian, he shall chose to deal by his historical method.

It is even conceivable, to some minds, that the vogue in history may at length alter so completely as to eliminate altogether the element of personal interest, and that historians will some day deal solely with the social masses that statisticians have measured. General Walker will then appear more of a historian, even, through the footed columns of the Tenth Census than through the footnotes and pages of "The Second Army Corps," and a more enlightened age will find in the tables and diagrams of a municipal report greater historical eloquence than its forbears admired in Michélet. Possible these things are: to me they do not seem probable. And it is plain that before they shall come to pass, "history," as a term common to all the European languages, must have revolutionized its accepted meaning. Today, being no prophet, I have endeavored rather to deal with it in the meaning which it seems yet to possess.

One more comment and I am done. If any one of you is disposed to feel that even in their own way historians have made but grudging use of statistics, I beseech him to reflect, first, how difficult it is to get statistics read—not intelligently, but at all—and, second, how small is the fraction of historical time for which statistics give any appreciable variety of information.

THE SERVICE AND IMPORTANCE OF STATISTICS TO BIOLOGY.*

By Raymond Pearl, Ph.D., *Biologist, Maine Agricultural Experiment Station.*

The key note of anniversary celebrations is traditionally the contemplation of the achievements of the past. The American Statistical Association is today celebrating its seventy-fifth birthday. This for an individual is a very respectable old age, even in this day of lactic defenses against senility. In the life of a society, however, and especially of this Association, seventy-five years mark merely the beginning of life—the attainment of full youthful vigor—rather than the approaching dissolution of old age. Statistical science, which has been so ably promoted by this Association during the years of its existence, is still a growing and a developing science. By the discovery of new methods its power to solve problems is every day becoming greater, and every day new problems are being put before the statistician for solution by workers in other fields of science. Only a short time ago I was told by a distinguished biochemist that in his judgment many of the most fundamental problems relating to the chemical physiology of the animal body could only be solved by the application of statistical methods. Without these methods but little real progress on certain of these problems had been made. Great as have been the achievements of statistical science and of this Association in the past, one may well believe that they mark but the beginning, and will be far surpassed by new developments and applications of statistical methods of reasoning, in fields now either untouched or only just entered upon.

It is about one of these newer developments of statistical science that I have been asked to speak today. This is the application of statistical methods to the problems of biology. While relatively a new field, this branch of science has developed very rapidly during recent years. It has been given a special name, biometry, and a number of universities now offer

* Paper read at the seventy-fifth anniversary meeting of the American Statistical Association, Boston, Mass., February 14, 1914.

courses in the subject. A special journal—*Biometrika*—devoted to this field is now in its ninth volume. This occasion marks, I think, the first formal recognition of the existence of this youngest of its daughter sciences by the parent science of statistics. It is a great pleasure to assist at this "coming out party," in which I shall essay something like the part usually played by the débutante's frock, endeavoring modestly to draw attention to and set off her inherent charms and graces.

The application of statistical methods to the study of biological problems other than those of anthropology may be said to have begun with the work of the late Sir Francis Galton. Galton was a born statistician. He tells in his "Memories" of the instinct, which he inherited from his father, to arrange, classify and collect statistics about all sorts of things. At the same time he was deeply interested in problems of biology, particularly those having to do with inheritance. His interest in this direction crystallized into definite activity at about the time when his cousin Charles Darwin was elaborating his theory of heredity, which was called pangenesis. Galton instantly realized that this conception of the physiology of the hereditary process was essentially statistical in character, and that statistical methods were demanded to test and broaden it. Upon this work he therefore embarked with the vigor and ardent enthusiasm which characterized all of his scientific work. His results found expression in a series of memoirs and books which have become classics in biological science. Of these the most important is perhaps "Natural Inheritance," since in it are brought to a focus a number of different lines of work which engaged Galton's thought and energy for many years. In this book the attempt is made for the first time to determine, on a statistical basis, the degree of resemblance, in respect of bodily, mental, and temperamental traits which obtains between relatives of different degrees. Previously no attempt had been made to measure precisely these resemblances, which were, of course, a matter of common observation, though not of precise definition, to everyone.

In order to make the desired analysis of this problem it was necessary for Galton to devise new methods of dealing with statistics. The general mathematical foundations of statis-

tical science had, to be sure, been laid by Laplace and Gauss, and some progress in the application of these methods had been made by the man usually regarded as the founder of modern statistics, Quetelet, who was an honorary member of this Association in its early days. But none of these men had dealt specifically with the measurement of what are now known as correlated variations. From Galton's point of viewing the problem of heredity such a measure was an absolute necessity. He, therefore, devised one. It was not altogether a perfect one but was practically usable, and led very shortly to the application, by other hands, of an old theorem of Bravais, which furnished the entirely adequate measure which Galton had sought.

To the end of his life Sir Francis Galton retained his interest in the science of biometry, of which he may truly be said to have been the founder. His keenness of interest served in great part as the primal inspiration and stimulus which led two other distinguished English workers to enter this field and begin to rear the superstructure on the foundation already laid. I refer to Prof. Karl Pearson of University College and the late Prof. W. F. R. Weldon, whose untimely death took from English science one of her most brilliant intellects and charming personalities. To Professor Pearson belongs the very great credit of developing adequate and general mathematical methods for the analysis of biological statistics. Statistical mathematics in the main fall within the realm of the calculus of probability. The foundations of that calculus were laid by Laplace and Gauss, as has already been pointed out. Since their day the most notable fundamental advance in the mathematical theory of probability has, in the writer's judgment, been due to the genius of Karl Pearson. Until he began his work all statisticians, astronomers, and physicists who had anything to do with the theory of probability, either from the standpoint of statistics or that of the theory of errors of observation, had been content to use the so-called "normal" curve of errors to describe the distribution of chance determined events. One of the characteristics of this curve is that it is symmetrical. According to it events above the mean are as likely to happen as events below the mean. Observed statis-

ties of natural phenomena were found, as a matter of fact, to give in many cases asymmetrical distributions. Indeed, some of the very examples used in the text-books to illustrate the normal curve do not accord with it when tested by an accurate measure of goodness of fit (for which extremely valuable instrument of statistical research we are again indebted to Pearson). That convenient scape-goat "chance" was appealed to, however, to account for the discrepancies. Starting from the sound position that the facts of nature are of more importance than any theory, even though it be one beautiful enough to excite worship,* Pearson in three classic memoirs, in the series of "Mathematical Contributions to the Theory of Evolution," developed a theory of skew frequency curves, and skew correlation, which took account of the asymmetry so frequently seen in chance determined phenomena. This system of skew frequency curves has had the test now of nearly twenty years' usage. Every attempt at destructive criticism which has been aimed against it has failed. None of the substitutes, some of which have been proposed by very eminent mathematicians, have shown any approach to the generality and elegance of these curves.

Few biologists have an adequate conception of the extent to which biometry is indebted to Prof. Karl Pearson. If, as has been maintained, every real advance in science depends upon the discovery and perfection of a new technique, then, for whatever advance in biology may come through biometry, the debt to that distinguished investigator will be large for many years to come.

With so much by way of historical orientation we may now turn to a consideration of the actual concrete results which the biometrical method of attacking biological problems has yielded. Here, of course, only a few of the more important and outstanding points can be touched upon. Anything like a complete review of the pertinent literature is clearly out of the question in view of the fact that the statistical method is literally coming to permeate all fields of biological research. Starting, as we have seen, with the application to the problems of heredity, biometric methods first were taken into other

* Galton always insisted that the Greeks would have deified the "law of error" had they known of it.

phases of the evolution problem, as, for example, variation simple and correlated, natural selection, homogamy, etc. From these fields to comparative anatomy and taxonomy was an easy step. The whole field of experimental embryology and *Entwicklungsmechanik* clearly offered splendid opportunities for the biological statistician to bring his new technique into operation, which he was not slow to realize. In the field of animal behavior and comparative psychology statistical methods have taken a prominent place in the investigator's armamentarium, doubtless the more readily because of the considerable development of *Psychophysik* in the domain of human psychology. Finally, and most recently, biometric methods are making a place for themselves in cytology.

Out of such a wealth of material it is difficult to single particular researches for special mention. Instead let us try to examine in the brief time at our disposal some of the more noteworthy results of biometry in certain broad general lines. Foremost stands the subject of heredity. Here a curiously complicated condition of affairs has existed. At just the time (1900) when biometric researches in this field were being most actively prosecuted by Pearson and his co-workers came the rediscovery of the work of Gregor Mendel, and the laws of inheritance which that work established. It was at once perceived that these results gave a fundamentally new conception of the physiology of the hereditary process. This was, in certain respects, completely at variance with the concept of heredity developed by Darwin and Galton, which had furnished the leading idea in the investigations of Pearson. In the judgment of the great majority of the workers in this field, the newer Mendelian principles rendered the older methods of research essentially futile. It appeared that they were not adapted to get at the real kernel of the problem. This opinion has gained strength with the passing of time. It led, however, to the premature and unfortunate conclusion that, because biometric methods as applied to the problem of heredity in one particular case and one particular way did not lead to fruitful results, therefore these methods were of no use under any circumstances in dealing with this problem. Happily this view found an immediate corrective in the

investigations of the distinguished Danish botanist, Prof. W. Johannsen. His "*Elemente der exakten Erblichkeitslehre,*" of which a new and greatly enlarged edition is just off the press, gave a clear demonstration that biometric methods, when guided by sound biological ideas, were not only a great aid in the elucidation of the problems of heredity, but were in fact essentials. These methods enabled Johannsen to demonstrate with convincing clearness the fundamental distinction between phenotypic and genotypic variations; those, on the one hand, which have to do solely with the soma and not at all with inheritance, and those, on the other hand, which are inherited. This is a most fundamental concept, upon which all modern progress in the study of this great problem is based. Furthermore by the aid of biometric methods Johannsen was able to show the real nature and mode of operation of selection, artificial and natural. These results mark a real debt of biology to statistics.

It may fairly be said that the results which have been obtained by the application of statistical methods to biological problems in the field of *Entwicklungsmechanik* stands second in importance only to those in the fields of evolution and heredity. Biometry has furnished a valuable adjunct to the experimental method in the analysis of many problems of morphogenesis. In particular attention should be called to studies on growth, and also to studies on the general tectonic of the organism. By the application of appropriate biometric methods two fundamental laws of growth of wide generality in both the plant and animal kingdoms have been established. The first of these relates to absolute growth increments, and states that as an organism increases in size the absolute increment per unit of time becomes progressively smaller, in accordance with a logarithmic curve. In other words, the size which an organism has attained, after having grown a given time, is a logarithmic function, simple or complex as the case may be, of the time that it has been growing. The second law of growth, which, like the first, appears to be of wide generality, relates to the variability of the growing organisms, and states that relative variability tends to decrease progressively as growth continues. The problem of growth has been par-

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ticularly studied from the biometrical standpoint, for some years past, by Dr. H. H. Donaldson and Dr. Shinkishi Hatai, of the Wistar Institute of Anatomy, using chiefly the white rat as material for investigation. The pioneer researches in this field were those of Prof. Charles Sedgwick Minot of Harvard Medical School, on guinea pigs. Other workers have studied with similar results the same problem in a number of plants.

Directly connected with the studies on growth has been the quantitative investigation of the principles of morphological organization. This I have referred to above as the problem of the general tectonic of the living body. This problem is one which has by no means as yet received the attention which is its due. It is one on which little real progress can be made except by the use of biometric methods.

Turning again to the general field of organic evolution a very important result of the statistical method has been the proof which it has given of the existence of assortative mating in the breeding of animals under natural conditions, and the measurement of the degree of this assortative mating or homogamy in particular cases. The significance of homogamy as a *vera causa* of evolution was first adequately emphasized by the post-Darwinians, and particularly by Romanes. He pointed out that: "Isolation takes rank with Heredity and Variability as one of the most fundamental principles of organic evolution. For, if these other two principles be granted, the whole theory of descent resolves itself into an inquiry touching the causes, forms and degrees of Homogamy." When this was written (1897) there was practically no definite and precise knowledge in even a single instance "touching the causes, forms and degrees of Homogamy." Since that time, as a result of the application of biometric methods to this problem, the degree of homogamy has been precisely measured in a number of cases, in some of which even its existence was not before suspected. Pearson and his co-workers have studied assortative mating in man. They have been able to show that for a wide variety of characters there is a definite and statistically significant degree of resemblance between husband and wife. Going to the other end of the

evolutionary scale it has been conclusively and independently demonstrated by Prof. H. S. Jennings of Johns Hopkins University, and the present speaker, that in the conjugation of Paramecium there is a high degree of assortative mating; "like pairs with like" to a marked degree. A rich harvest awaits further tilling of this field. Clear as is the significance of homogamy as a factor in evolution when viewed from the older standpoint emphasized by Romanes, the whole matter gains added significance in the light of the newer studies of heredity. The important investigations of Prof. E. M. East of Harvard University on heterozygosis clearly indicate, as a collateral issue, the significance of studying the degree of assortative mating which occurs in the reproduction of wild forms, for homogamy tends automatically to produce homozygosis. It may be said that we are not likely to gain any adequate conception or measure of the significance of heterozygosis as a factor in organic evolution until we have in hand the results of more extended investigations than have yet been made regarding the frequency of occurrence and degree of assortative mating in nature.

We may now turn in conclusion to the more general and philosophical aspects of the relation of statistical science to biology. As I have elsewhere pointed out, "the real purpose of biometry is the general quantification of biology. Its fundamental viewpoint is that without a study of the quantitative relations of biological phenomena in the widest sense it will never be possible to arrive at a full and adequate knowledge of those phenomena. This viewpoint insists that a description which says nothing about the magnitude of the thing described is not complete, but, on the contrary, lacks an element of primary importance. It insists, also, that an experiment which takes no account of the probable error of the results reached is inadequate and as likely as not to lead to incorrect conclusions."

Statistical science has brought to biology three fundamentally important things which it had previously lacked. These are: first, a method of describing a *group* of individuals in terms, not of its component individuals, but in terms of its (the group's) own attributes and qualities; second, the con-

cept of "probable error," which makes possible an estimate of the probable accuracy of a series of observations; and third, a method of measuring the degree of association or correlation between the variations in a series of characters or events. Time is lacking to develop each of these points, nor is it necessary, for they have been discussed in detail elsewhere.

In what has preceded I have tried to show that by turning to statistical science for aid the biologist has greatly augmented his powers of analysis in the domain of his own particular problems. While the branch of science, which has been called into being by this coalition, is yet too young to have shown its full capabilities, yet I think its achievements have been sufficient in quality and amount to justify the belief that its position is secure and its promise bright. Biometry seems destined to become a permanent and important branch, at once of biological investigation and of statistical inquiry.

THE TECHNIQUE OF PUBLIC STATISTICAL EXHIBITS.

By Charles J. Storey, *Supervisor of Exhibits, New York State Department of Health.*

The effective presentation of statistics in a public educational exhibit is fraught with great danger if the statistican exhibitor does not put himself in the public's place and design his exhibit from their standpoint rather than from his own. In fact, in more than one exhibit addressed to the poor of our cities and largely attended by them, statistics of a very complicated nature have been shown in an equally complicated manner; and although they, no doubt, occasioned curiosity and remark because of numerous brightly colored lines, they gave no instruction. The exhibitor should first of all study the viewpoint of the audience to be addressed. He must understand the mind of the public.

For an exhibit of statistical material, as for any exhibit, the preliminary plan should center around some real reason for the exhibit. This should be evident throughout the entire exhibit and should join the parts into one continuous whole. There should be a beginning, a climax, where a certain big idea should stand out, and an end.

The end of the exhibit should be as interesting as the beginning, and the climax, or the one thing emphasized above all others, should be so compelling that everyone who enters the exhibition will pass out with it in mind.

Preliminary plans of exhibits are usually good because it is much easier to outline an exhibit on paper than to transpose the same outline into exhibitable form. A recent exhibition had one of the best preliminary plans I have ever seen. It was orderly, in sequence, and complete, but the exhibit installed was just the reverse. In transposing from the written outline to the actual presentation and arrangement, someone had failed. The failure was, no doubt, due to lack of a good detailed working plan around which the exhibit is actually built.

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An excellent way to see the exhibit as it will be when installed is to work what may be called *preliminary* filling cards on which every chart, placard, poster, etc. is described or duplicated, and indexed under its appropriate division. Nothing should be left to chance and every word and scheme of presentation should be under inspection and subject to revision as the preparation of the exhibit progresses. A final index of the material may be made when all the material is in and arranged. If this final index is made in duplicate, a good part of it may be used as a copy by the letterer or draftsman.

For a public educational exhibit, statistical information should be presented in the simplest possible manner. I have seen exhibits in the preparation of which the poor public was apparently never considered although the exhibits were avowedly made for them. Few people will bother to read many curves or to study out intricate charts. One of the best ways to get an idea of what the public will read or study is to scan the advertising pages of our good monthly magazines. The advertising man knows better than anyone else today just how much the public will read before the page is turned for something more interesting. He also knows what will attract and how to make it attractive. A telling advertisement does not require intensive study. It is prepared to compel attention and to force a certain idea upon the observer.

An exhibit should be entertaining. No matter how valuable the material presented is, if it is not entertaining, the points are lost. The motive back of an exhibit may be as serious as possible yet it must not be forgotten that the general public attends exhibits not to study but to be amused. The pill must be coated and the most clever exhibitor is he who does this best.

Simplicity and brevity are the keynotes of the successful exhibit. One should have much to select from but should select little. Too many exhibits have lost in effect by the quantity of material used. This is caused by the mistaken idea that the larger the exhibit the more successful it is.

Variety of display is far more important than variety of material. Poor material well displayed will teach more than the best ideas presented in a monotonous and unattractive

form. An exhibitor must have many methods of presentation. Uniformity of method is deadly. Everything in an exhibit should be designed in competition with the rest and everything should hit out and attract the observer.

An exhibit should be planned to show only the basic or principal points of the subject. One should not try to present all the arguments. A successful exhibit should be suggestive of the subject rather than complete. The main idea of an exhibit should be to make people think and to arouse interest for further study of the subjects presented. The ideas expressed should connote others. Detailed information may be exhibited in small form as in wall cabinets or albums which those interested may study but which the hurried or disinterested observer can pass by. Many exhibits are filled with inconsequential detail from the midst of which the vital points have a hard task to make themselves known. If an idea cannot be expressed in twenty words, it should be printed in a pamphlet and be given publicity that way.

Then again, big ideas are often too feebly expressed. Vigorous, terse expressions combined with size will put an idea to the forefront. A minute chart will not be noticed no matter how valuable it is. The size and arrangement of an idea to be expressed must be designed in relation to the surrounding exhibits.

The exhibit should have high lights or points of attraction. A certain uniformity of installation is desirable such as backgrounds and framing but variety of display is absolutely necessary. Moving exhibits attract more than anything else. Bright colors also invite attention and lend an attractiveness to an exhibit. White lettering on gray or black is hard on the eyes and not nearly as attractive as black letters on a gray or light buff back-ground. Roman or else block letters are the most readable. It is easier to read words composed of caps and lower case letters than words of all caps. The size of lettering must also be carefully considered and no letters should be used which cannot be easily read at least twenty feet away.

The statistician should not confine his means of expression to charts. Although graphic in form, if made for public

exhibition, they will usually be found too complicated, and a row of charts will drive most visitors away. This may be sad news for statisticians but it is, nevertheless, true. Only the very simplest curves should be use and these sparingly. One comparison on a chart is all that should be shown as more confuse. It must be remembered that most people read very few statistics in their day's work. If they can understand them, they find them too wearisome to concentrate their attention on them very long in an exhibit. Where there are simpler things to look at they go to them.

Comparisons by means of lines, either parallel or perpendicular, are easily grasped although, as mentioned, there should be only one point to be brought home. The comparisons should be plainly made and no complicated "keys" or systems of notation used.

Maps used to illustrate the geographical distribution of statistics should be utilized as sparingly as charts. In fact any one method of display cannot be employed very many times in an exhibit if the attractive value of it is to be retained. Where a map is used, it should be drawn so that everything is eliminated except the geographical data, such as boundaries and cities, necessary to present the facts or comparison. Showing statistics in a concrete form such as blocks of different sizes is an old and interesting method. Everyone remembers the exhibit of the number of tickets annually sold at subway stations, first shown at the New York Budget Exhibit. A map several feet long of Manhattan and the Bronx was used from which at the designated stations colored sticks of proportionate heights were placed.

To translate statistics into cartoons or posters is a popular and valuable method to bring home necessary information. For instance, one cartoon seen recently pictured a waterfall, the flow of water illustrating the enormous infant mortality, which when compared to the number born (contents of the reservoir) was extremely effective. The figures and percents were lettered in their respective places and the whole taught a lesson which no amount of unaided statistics could have done. When comparisons are made, appeals to past experi-

ences of the observer should be made; that is by the use of homely illustrations.

A striking method of "coating the pill" is to combine statistics with a few words of text. These figures should be round numbers wherever possible as they are more easily and quickly read. Most persons mentally reduce a large number to its nearest thousands or hundreds as the case may be. For the same reason, unless the number or percent is very small, not more than two decimal places should be used and preferably none at all. Cents should be left out of items whenever possible as they serve only to confuse.

In an exhibit where one idea or item is considered many times, a helpful way is to always put the figures or symbol in a distinctive color. This will aid the observer to recognize the figure at once and it will also serve as a starting point for his interest.

THE INFLUENCE OF MARRIAGE ON THE DEATH-RATE OF MEN AND WOMEN.

By George I. Bliss, A. B., AA. A.

Prof. Walter F. Willcox, in his sixth annual report to the New York State Commissioner of Health, submitted some very interesting tables as to the influence of marriage on the health of men and women. His study was based on the population and deaths of New York state outside of greater New York and Buffalo for 1909–1911. Prof. Willcox showed that the death-rate of husbands is much lower than that of bachelors at each age group, except 80 and over; and that at the ages from 30–49 the death-rate of the former is less than one half of that of the latter. He likewise showed that the death-rate of married women is lower than that of spinsters at each decennial age group, excepting 20–29, as it is set forth in the following table:

TABLE I.

POPULATION, DEATHS AND DEATH-RATES CLASSIFIED BY SEX, AGE, AND MARITAL CONDITION, NEW YORK STATE (EXCLUSIVE OF NEW YORK CITY AND BUFFALO).

(Average of 1909, 1910, 1911.)

MALE.

Age Period.	Single.			Married.		
	Population.	Deaths.	Death-rate.	Population.	Deaths.	Death-rate.
20–29	231,625	1,532	6.6	128,339	533	4.2
30–39	76,614	986	12.9	229,128	1,344	5.9
40–49	37,172	724	19.5	196,465	1,856	9.5
50–59	21,142	607	28.7	144,972	2,466	17.0
60–69	9,881	504	51.0	98,673	3,151	31.9
70–79	3,759	381	101.4	40,015	2,910	72.7
80 and over	754	154	204.2	6,134	1,258	205.1

TABLE II.

FEMALE.

Age Period.	Single.			Married.		
	Population.	Deaths.	Death-rate.	Population.	Deaths.	Death-rate.
20–29...........	145,537	684	4.7	176,583	1,006	5.7
30–39...........	54,769	405	7.4	227,473	1,428	6.3
40–49...........	35,812	357	10.0	187,947	1,536	8.2
50–59...........	19,389	386	19.9	124,673	1,803	14.4
60–69...........	12,062	448	37.1	68,781	1,933	28.1
70–79.........:	5,623	462	82.2	21,112	1,296	61.4
80 and over......	1,058	296	279.8	1,848	360	194.8

The results were so startling that they aroused a good deal of comment in the daily papers, and merit further investigation. But in view of the dearth of reliable statistics on this study in the United States I resorted to the well-known letters of Dr. James Stark to the Registrar-General of births, deaths, and marriages in Scotland, and found very interesting tables on this subject.

I therefore submit the following table showing the population and deaths of married and unmarried men at each quinquennial age group and the death-rate per 1,000 living:

From the Ninth Detailed Report (1863).

TABLE III.

MARRIED AND UNMARRIED MEN IN SCOTLAND.

Ages.	Married.			Unmarried.		
	Number Living.	Deaths.	Death-rate.	Number Living.	Deaths.	Death-rate.
20–25...........	22,946	137	6.0	106,587	1,251	11.7
25–30...........	54,221	469	8.7	48,618	666	13.7
30–35...........	66,153	600	9.1	25,962	383	14.8
35–40...........	63,858	690	10.8	15,857	253	16.0
40–45...........	62,645	782	12.5	12,311	208	16.9
45–50...........	54,505	869	15.9	8,824	179	20.3
50–55...........	49,591	880	17.7	7,636	205	26.8
55–60...........	38,006	929	24.4	5,550	142	25.6
60–65...........	35,920	1,216	33.9	5,242	227	43.3
65–70...........	22,021	1,134	51.5	2,848	156	54.8
70–75...........	16,029	1,291	80.6	2,021	205	101.4
75–80...........	9,716	1,135	116.8	1,081	157	145.4
80–85...........	5,477	953	174.0	513	101	196.9
85–90...........	1,708	488	285.7	151	32	211.9
90–95...........	449	137	305.1	50	21	420.0
95–100.........	103	40	388.4	6	3	500.0
100 and above...	28	15	535.7	3	.....	.....
All ages.......	503,376	11.765	23.4	243,259	4,189	17.2

The first striking fact which this table reveals is that the death-rate of the bachelors was double that of the married men between the ages of 20 and 25. As its persons became older, this excessive difference in the death-rates of the married and unmarried decreased slowly and regularly, showing the difference in favor of the married men at every period of life. It is thus proved that the state of bachelorhood is more destructive to life than the most unwholesome trades. When we come to the total death-rate at all ages, however, the very reverse is the case. The general death-rate among married men is very much higher than that among single men; so that, while only 1,723 bachelors died during the year out of every 100,000 bachelors, 2,338 married men died out of a like number of married men.

This apparent contradiction may be explained as due to the fact that the number of bachelors being far greatest at that period of life when the mortality is very low, namely, from 20 to 24, whereas the number of married men is greatest at those periods of life when the mortality is high, seeing that the mortality increases with age. Furthermore, almost half of all the deaths of the bachelors occur before the thirtieth anniversary, at which period the mortality is much lower than at the more advanced periods of life. When the whole deaths at all ages are thrown together and compared with the total bachelors living, the general mortality seems to be little higher than that due to the earlier period of life. Among the married men, on the other hand, the greatest number of deaths occurs between the sixtieth and seventy-fifth year of life, at which period the mortality is high as compared with the number living. Consequently, when the total deaths of the husbands of all ages are compared with the total living, a high mortality seems to have prevailed, because the persons were all so much older when they died than were the bachelors. Therefore, comparing the total deaths of the married at all ages with the total deaths of the bachelors, necessarily leads to a false conclusion. In comparing mortality rates of two or more classes, to be correct, it must be limited to comparing at each age group, and the smaller we take the age group the more nearly correct are the rates.

Before we proceed to compare the facts relative to the very different death-rates of the married and unmarried men in the whole population of Scotland for the year 1863 with those brought out by Professor Willcox we must bear in mind that the widowed and divorced were included among the married men in the former, while in the latter they were tabulated separately. According to Professor Willcox the death-rate of widowers and divorced men is very much higher than that of husbands of the same age and about the same as bachelors between the ages 30 and 80. Making due allowance for the widowed and divorced men Table I is in every point corroborated by Table III. Had Professor Willcox tabulated his statistics in quinquennial ages he would, doubtless, have found the relative difference in the death-rate between husbands and bachelors higher between 20 and 29 and also higher for ages 80 and over.

In view of the striking difference between the death-rates of married and unmarried men shown to exist at each quinquennial age in the population of Scotland for the year 1863, it was decided to investigate the subject further. Accordingly another table was prepared based on the statistics of 1864. It is not necessary to give the table here but I might mention the fact that it corroborated in every point the preceding one.

The different death-rates prevailing among married and single men in Tables I and III were brought out by a comparison of the deaths with the living, where the correctness of the conclusion rests on the truthfulness of the numbers of the married and unmarried as ascertained at the census. But the correctness of the conclusion may be tested by estimating the mean age at death of the married and the unmarried, and if the two results corroborate each other, we may place greater confidence in the results deduced from the facts.

I have calculated the mean age at death of all the husbands and bachelors from 20 to the close of life and find that the mean age at death of husbands in Professor Willcox's table was 60.0, whereas the mean age at death of the bachelors was only 43.6, a difference of 16.4 years. In Table III the mean age at death of the married was 59.7, whereas the mean age at death of the bachelors was 40 years, a difference of 19.7 years.

It would appear that the husbands in New York State (outside of New York City and Buffalo) have a chance of living 16.4 years longer than those who remain bachelors; and that the married men of Scotland have a chance of living 19.7 years longer than the unmarried.

These statistics seem to prove that the married state is best fitted for mankind. The married man is, in general, not only more healthy, vigorous, and free from the diseases of the unmarried, but he is also more regular in his habits, is better housed, better fed, and better attended to. The married men may be accounted as selected lives; for the weak, the delicate, those suffering from disease of any kind, the dissipated and the licentious are not as likely to marry, so that a larger proportion of such are found among the ranks of the unmarried men; and these are known to die at a much higher rate than the robust and temperate. This is the natural explanation of the difference which exists in the death-rates of the married and unmarried.

The various reasons enumerated above, however, would only account for the difference in the death-rate of the married and unmarried during the earlier years of life, say from 20 to 40 years of age, but quite fails to explain the difference in the death-rate at the higher ages, for almost all those who remain unmarried from natural infirmity of constitution, or from being addicted to intemperate or licentious habits, die before they have attained their fortieth anniversary. Very few survive the critical age of 50. Therefore, all bachelors who survive their fortieth year, and certainly all those above 50 years of age, must be considered as selected lives; and the difference found to exist in the death-rates of the married and unmarried in that period of life can reasonably be attributed to causes connected with their being married or unmarried.

In the seventh and eighth detailed annual report (relating to the year 1861 and 1862 in Scotland), attention was directed to the influence of marriage on the death-rate of women. Two tables were published, based upon the return of 1861 and 1862, showing the different death-rates which prevailed at each quinquennial period of life of those who were married, and those

who were unmarried. The widows and divorced women were included among the married.

The following table shows the number of the living, and deaths of the married and unmarried women at different ages, in Scotland in 1862, and the death-rates per 1,000 living at each age group:

TABLE IV.

MARRIED AND UNMARRIED WOMEN IN SCOTLAND IN 1862.

Ages.	Married.			Spinsters.		
	Number Living.	Deaths.	Death-rate.	Number Living.	Deaths.	Death-rate.
20-25........	39,924	364	9.1	114,180	895	7.8
25-30........	71,649	683	9.5	61,044	506	8.3
30-35........	77,503	764	9.9	34,954	367	10.5
35-40........	71,962	806	11.2	24,368	300	12.3
40-45........	69,660	806	11.7	19,690	225	11.4
45-50........	58,984	785	13.3	14,659	222	15.1
50-55........	54,479	826	15.2	13,973	269	19.3
55-60........	41,462	886	21.4	10,216	244	23.9
60-65........	42,390	1,200	28.3	11,405	370	32.4
65-70........	26,242	1,242	47.3	6,875	350	50.9
70-75........	20,237	1,342	65.5	5,544	434	78.3
75-80........	12,190	1,424	116.8	3,230	359	111.1
80-85........	7,490	1,278	170.6	1,986	332	167.2
85-90........	2,648	708	267.6	582	161	276.6
90-95........	763	282	369.7	181	55	303.9
95-100........	203	94	463.1	48	20	416.7
100 and above....	34	17	500.0	23	3	130.4
All ages.......	597,868	13,507	22.6	322,958	5,112	15.6

Comparing the mortality of the married and unmarried women at every quinquennial age group, it is seen that the high death-rate of the married women appears to be confined to the ages under 30 years; but that from 30 to 39 years, the death-rate of the married women falls below that of the spinsters. At the ages 40 to 44, the mortality of the married again slightly exceeds that of the unmarried. From age 45 to old age, however, the married die in smaller proportion than the unmarried.

The results brought out by this table as to the difference in the relative mortality between married women and spinsters are practically the same as by Professor Willcox's table excepting at the ages 40 to 44, and again at the extreme ages 75 and upwards. In the former table the mortality of the married, at ages 40 to 44, slightly exceeds that of the spinsters,

whereas in the latter table the mortality of the spinsters exceeds that of the married. Had Professor Willcox, however, given the death-rate by quinquennial age-groups, it would probably have shown the same break, for if we combine the two quinquenniums in the former we find a higher death-rate for the spinsters. At the extreme ages again the higher death-rate shown among married women than among spinsters is due to the fact that widows and divorced women were included in the former table and the high death-rate was probably caused by widows, who generally predominate at this period of life.

It appears that the higher death-rate suffered by the married women below the thirtieth year of life is probably caused by the greater danger to life which attends the bearing of the first child, for at this age period a large proportion of married women give birth to their first child. But when that age was attained when the great majority of married women had survived the birth of their first child, namely, above 30, the mortality of the married women fell below that of the unmarried. From 40 to 45 when the usual "change of life" occurs, the mortality of the married again exceeds slightly that of the unmarried. But from 45 to old age, the death-rate of the married is distinctly better than that of the spinsters. Above age 75 the relative mortality fluctuates, but the numbers are too few to draw any conclusions.

It is worthy of consideration how far the higher rate of mortality shown to exist among spinsters above age 30 may be due to extensive understatement of their ages. If the spinsters were on the average three years older than they represented themselves to be in the census returns, and the ages of the married women were correctly given, this would probably fully account for the greater apparent mortality of the spinsters.

The relative mortality of spinsters and married women among insured had been recently investigated by the Medico-Actuarial Mortality Investigation Committee, based upon the experience of forty-three life insurance companies (M. A. M. I. Vol. II, page 36). It showed a distinctly lower mortality for spinsters than for married women, excluding widows and divorced women, at every age group, the average difference

for all ages being 38 per cent. in favor of spinsters. The favorable mortality of the spinsters as compared with the married women deduced from insurance statistics, however, is not a characteristic of the class in the general population. The great majority of spinsters insured by the companies were teachers, stenographers, librarians, and other similarly favorable types. Only a small proportion of them were employed as saleswomen in the stores, or were engaged in factory work. Therefore, these statistics of the insured women do not disprove the conclusions reached by Professor Willcox and fully corroborated by the tables from Scotland, that the influence of marriage on the death-rate of the female sex, though not so potent as on the male, is considerable.

THE NEED OF A FEDERAL TRADE CENSUS.*

By Melvin T. Copeland, *Instructor in Commercial Organization, Harvard University.*

The study of domestic trade in the United States is seriously hindered by the dearth of readily accessible information. To facilitate researches in this field there is a need of a federal census of market distributors—dealers in raw materials, commission merchants, wholesalers, and retailers. These merchants make up a numerous and, in general, a necessary class in our population. Their activities affect every inhabitant of the country. There would be a widespread and vital interest, therefore, in the results of a census which would show how many people are gaining their livelihood from trade, the number and size of stores of the various classes, their geographical distribution, and the amount of their business.

Such trade statistics would give enlightenment upon subjects of general and local concern. What is the ratio of retail stores to population? Is the total number or the number of any class of stores increasing relatively faster than population, or is it relatively decreasing? We can only guess. Some cities are primarily jobbing centers; their manufactures are comparatively unimportant. But through a change in freight rates or for other causes their trade and their prosperity may be slipping away. In other cities the jobbing trade is rapidly expanding. But all the estimates of wholesale or retail trade now made are apt to be biased or inaccurate and are altogether inadequate. Reliable information concerning the volume of trade and the agencies through which it is carried on can be obtained only by a federal census.

The costs of market distribution are by no means light. Many commodities of every day use such as cotton cloth, clothing, shoes, and groceries, ordinarily yield the wholesaler and retailer together a total gross profit of at least 30 to 40 per cent. of the retail price. Although, as a rule, the wholesale and retail trades are not great fortune makers, the total cost

* Paper read at the quarterly meeting of the American Statistical Association, Boston, Mass., December 9, 1913.

of distributing finished products to the consumers not infrequently exceeds the amount paid for the raw material plus the costs of manufacturing. With a view to economy attempts are continually being made to shorten the route from the factory to the consumer. Traditional market methods are upset. A life and death conflict ensues. Twenty years ago most of the shoes manufactured in the United States were handled by jobbers; now the proportion is, perhaps, one-half and shoe manufacturers have even gone so far as to operate their own retail stores. Textile manufacturers have been dispensing with the services of commission agents. Some manufacturers of goods retailed through grocery stores no longer sell to wholesalers but direct to retailers. "Trusts," have in some instances either ceased to sell to jobbers or have at least restricted the amount of trade handled by that class of middlemen. It was the jobber and the retailer, not the consumer, who felt oppressed by the old American Tobacco Company.

New types of retailers—department stores, chain stores, coöperative societies, and mail-order houses—have, on the other hand, become such large scale purchasers that they have demanded and received jobber's discounts. As a consequence they can undersell the small independent retailer and threaten his very existence. Before this bitter strife reaches its climax a demand may be heard for restrictive legislation, such as the department-store taxes of the German states. In fact some attempts have already been made to secure the passage of a law prohibiting the giving of rebate coupons in the retail tobacco trade. The question of price maintenance, the right of the manufacturer to compel observance of a fixed retail price, has not been settled by the recent decision of the Supreme Court in the Sanatogen case. The issue will attract more attention from our legislators in the future than it has attracted in the past. One of the most forceful arguments in favor of price maintenance is that it tends to protect the smaller retailer against the price-cutting policy of the department stores and the chain stores. The results of these changes in marketing methods can, at the present time, be judged only in a general way. We have no reliable statistical information to show how far the changes have gone nor what the actual tendencies

are. By giving us facts a federal trade census would enable a more intelligent consideration of the questions of public policy involved.

In order to analyze their markets, manufacturers and large mercantile houses have sought statistics of the number of wholesale and retail stores which could serve as outlets for their goods. To meet this demand lists have been prepared by several agencies, samples of which are given in the table below. Although in several instances these lists correspond with each other fairly closely, they are, in the main, widely divergent. List A was published in the *Mahin Advertising Data Book,* 1913; List B in *Printer's Ink,* January 18, 1912; and List C in *Advertising and Selling,* April, 1912.

NUMBER OF RETAIL STORES.

Territory.	Drugs.			Hardware.			Jewelry.		
	List A.	List B.	List C.	List A.	List B.	List C.	List A.	List B.	List C.
United States	43,588	45,170	37,074	30,504	29,446	27,270	21,694	20,145	18,249
New York	2,528	3,965	1,830	2,005	2,636	1,430	1,544	2,132	1,290
Pennsylvania	2,342	3,315	2,460	1,576	2,393	[illegible]	1,405	1,702	1,470
Ohio	1,469	2,099	2,052	2,037	2,288	1,770	1,345	1,163	1,230
Illinois	1,766	2,839	1,787	1,967	2,995	[illegible]	1,152	1,431	1,101
Missouri	2,518	2,407	2,370	1,267	1,982	[illegible]	908	896	670
Maine	407	406	*	263	403	*	250	253	*
Georgia	991	1,041	*	313	586	*	309	363	*

* Data not given.

These are all reputable publications which would not willingly, I think, circulate inaccurate statements. The figures given here for three trades in seven states are typical in indicating the discrepancies which exist between all such figures. As a brief examination will show the variations are not uniform. The list with the largest total for the United States does not give the largest number for each of the individual states; note the figures for drug stores in Missouri and for jewelry stores in New York, Pennsylvania, and Illinois. And the list with the smallest total for the United States sometimes has the largest number for an individual state; note the figures for hardware stores in Illinois. Although doubtless due in part to variations in definition, the discrepancies throughout are irreconcilable. This is sufficient answer to the argument that the collection of such information should be

left to private investigations. In a federal census the definitions would be standardized and the statistics more accurate. The information thus provided would be of distinct help to business men.

The only attempt at an official collection of such trade statistics was made in the Massachusetts census of 1905. The schedule was simple but included several of the questions which should be asked in the proposed federal census. No serious difficulties were experienced in the collection of the information. Nevertheless the results as published have little worth. Largely because of the urgency of the work on the population and manufacturing censuses, which had the right of way over the trade census, the classification and tabulation of the trade statistics were not satisfactorily carried out. This was shown most strikingly in an incongruous combination of wholesale and retail figures. Despite its non-success, however, the experiment does not indicate that there are any insuperable obstacles in the way of a federal trade census; on the contrary, it makes the proposal appear more practicable.

It is to be frankly recognized that, as in other census work, nice problems of definition and classification will be encountered. There will be omissions and duplications, as in the manufacturing census. In the Abstract of the Thirteenth Census (p. 514) it is stated that: "The figures for some industries do not represent the total production, because important establishments that manufacture the same class of products may be included in other industries." Other qualifications are appreciated by all who have had occasion to analyze carefully the census statistics. Yet the results are generally accepted as approximately correct, and the percentage of error would probably not be higher in the trade census. In filling out some of the schedules for the trade census it might be necessary to accept estimates, but it is doubtful if this would occur as frequently as in the agricultural census.

Under present conditions and with the type of enumerators which must be employed, it would be a hopeless task to try to secure statistics of costs of store operation. The accounting systems of large establishments are diverse, and many small stores have only a haphazard system of bookkeeping or none at

all. The Bureau of Business Research of the Harvard Graduate School of Business Administration found it essential to prepare a uniform system of accounts before it could obtain comparable figures for the costs of retailing shoes. Hence, whatever the federal government may eventually do in this line of investigation, no question about costs should be included in the schedule for the first trade census.

The following questions seem to be the most important of those practicable to ask:

1. Kind of business carried on.
2. State whether specialty retail store, department store, general store, coöperative store, mail-order house, wholesaler, jobber, commission merchant.
3. Number of stores operated (*i. e.,* branches).
4. What proportion of goods sold is manufactured by proprietor.
5. Actual capital, owned and borrowed, invested in the business.
6. Net cost of goods sold during year.
7. Total amount of sales during year.
8. Number of employees:
   Male, 16 years of age and over.
   Female, 16 years of age and over.
   Children.
   Total.

The results of the questions concerning the age and sex of employees would shed light upon the labor conditions in certain classes of stores. In addition some inquiry concerning wages ought to be made, the more comprehensive the better. Unless preliminary investigation proved it to be inexpedient, it is suggested that informaton be collected from department stores and general stores as to the amount of their sales of each of several groups of commodities, such as footwear, dry goods, hardware, furniture, and groceries and provisions. It would be inadvisable to undertake to follow out this line of inquiry in all its possible ramifications but for the broader classes significant statistics could probably be obtained.

As to the date of such a census, it was at first proposed that

it should be taken in 1915, in connection with the census of manufactures. But in view of the comparatively short time which would then be allowed for planning the schedule and also because of the delay in tabulation which might result from pressure of work on the manufacturing statistics, it would, perhaps, be more feasible to take the trade census at a date intermediary between 1915 and 1920, say 1917. This would relieve somewhat the fluctuations in the burden placed upon the census bureau.

Practically all of the arguments in favor of a census of agriculture or manufactures apply also to the proposal for a trade census, particularly since this trade census does not appear to involve more serious statistical problems nor a prohibitive cost. The number of persons engaged in trade is so great, their relation to our whole economic life is so intimate, the costs of marketing are so high, and such fundamental changes are taking place in market organization that we need reliable trade statistics which can be secured only through a federal census.

THE NUMBER OF JEWS IN NEW YORK CITY.

By Henry Chalmers, *Cornell University*.

The increasing prominence of the Jew in the manifold activities of the metropolis gives interest to the repeated estimates as to the number of Jews in New York City. For some time the figure has been roughly given in articles and addresses by public men as "about one million"; but seldom has any attempt been made at accuracy or any definite basis been given for the varying figures. The United States census not being permitted to make inquiry of individuals as to their religion, no census estimate is available. In the census of 1910, for the first time, the question of "What is your mother tongue?" was asked. It appears that in New York City 861,980 persons reported Yiddish or Hebrew as their mother tongue. But this is undoubtedly an underestimate, as many Jews born in Germany, for instance, consider German their native tongue; moreover, Jews of the second generation who have become Americanized are more apt to report English than Yiddish as their native tongue.

The only recent efforts at exact estimate of the number of Jews in New York City, to my knowledge, are those of Dr. J. Jacobs, editor of the *American Hebrew*, and Dr. Walter Laidlaw, secretary of the New York Federation of Churches, both made early in 1912. Dr. Jacobs* estimates the number at 906,000 on January 1, 1912; while Dr. Laidlaw† finds it to be 1,265,000 on April 15, 1910, which, when carried forward to January 1, 1912, by his method, reaches 1,365,000. In view of the divergence between the two, the larger exceeding the smaller by 50 per cent., I have attempted to analyze their methods and reconstruct the estimate on a better statistical basis.

Dr. Laidlaw's estimate is based on a house-to-house racial and religious census of certain sections of New York City conducted by the New York Federation of Churches at various dates since 1895. Ten years ago he computed the percentage

*New York Times, January 27, 1912, page 4.
†New York Times, February 10, 1912, page 10.

of the various nationalities whose families reported themselves as Catholic, Protestant, and Jewish and published the following distribution of the population of New York as in 1900:

	Number.	Per Cent.
Roman Catholics,	1,266,561	37
Protestants,	1,572,629	46
Jews,	598,012	17
Total	3,437,202	100

Applying to the population of New York in 1910 the same percentages as were applied in 1902, he estimates the Jewish population on April 15, 1910, at 1,265,000. Carrying out his rate of increase for the decade, I get for January 1, 1912, an approximate total of 1,365,000.

Dr. Jacobs, of whose first estimate Dr. Laidlaw's figures were a criticism, replied in a later issue of the *New York Times,** declaring he was unconvinced by the Federation's computation for these reasons:

"First—If Dr. Laidlaw's figures were correct, the Jewish death-rate of the city would be 8.25 per 1,000, an impossible figure. (The death-rate for the general population in 1910 was 16 per 1,000.) Again, it would work out a marriage rate of 6.25, when that of the city was 9.66.

"Second—Dr. Laidlaw's inquiries seem to have extended over the last fifteen years, during which the marked characteristic of the Jewish population has been its mobility. It is likely enough, therefore, that his inquirers have frequently met with the same families and counted them over and over again.

"Third—Jewesses have larger families than others, while, on the other hand, there is a larger proportion of single young men among the Jewish population of the city. These facts would disturb Dr. Laidlaw's percentages based, as I understand, on the nationalities of Jewish mothers, and

"Fourth—Dr. Laidlaw's researches apply mainly to the congested districts, where the Jews mostly congregate. Obviously there is likely to be a larger proportion of Jewish

*New York Times, February 12, 1912, page 10.

families in the tenement districts than in the 'Silk Stocking' districts. Hence, his results are sure to exaggerate the size of the Jewish element when applying the percentages derived from congested sections to the census figures of the whole city."

In addition to these obvious criticisms of Dr. Jacobs, the essential weakness of his method, to my mind, is that it lacks the essence of a census count—a detailed photograph of the population as it stood at a certain point of time. A long-continued exposure of a moving object is apt to give a very confused and inexact negative. While interesting as a sociological study of the religious make-up of certain sections of New York City, the Federation's count extended over the fifteen years between 1895 and 1910, during which, as Dr. Jacobs suggests, "the marked characteristic of the Jewish population of the city was its extreme mobility." They have moved uptown and across the bridges, absorbing vast numbers of newcomers and losing old members. Not only is it probable that the same family has been met and counted more than once, but that others were omitted altogether. Moreover, the Jewish population of the city is marked by an unusually large number of young men and women who are here without any family, and so the Federation's basis of the nationality of the mother of the family could take these into account, if at all, but very roughly. To assume that in 1910 the three main religious divisions—Catholic, Protestant, and Jewish—claimed the same proportion of the total population as the Federation estimated in 1900 is to take no account of the vast changes continually going on in the make-up of a seething center and port of entry like New York City.

In view of these weaknesses in method, it is hardly to be expected that Dr. Laidlaw's estimate of 1,265,000 in 1910 and 1,365,000 in 1912 would be anything but a crude approximation.

Dr. Jacobs's first estimate of the number of Jews in New York was made in 1902. Starting with the number of Jewish deaths reported in 1901, he computed the number of Jews at that time as 600,000, which the *New York Times* declares was generally accepted, though at first considered surprisingly

large. He obtained it by assuming that, while the death-rate of the whole city was 20, that of the Jewish element was 14 per 1,000, "which I fixed upon for various good reasons." He assigns no further reason for assuming a death-rate 30 per cent. smaller than that of the general population except to suggest that the Jewish element contained a larger proportion of persons in the healthy ages. The number of Jewish burials increased 38 per cent. from 1901 to 1910. While the general death-rate of the city decreased some 23 per cent. in that period, Dr. Jacobs assumed that the Jewish death-rate decreased only 3.5 per cent., or from 14 to 13.5 per 1,000. Upon that basis, of 13.5 deaths per 1,000 population, he gets an average Jewish population during 1910 of 820,000. Adding to that the number gained by immigration and excess of births over deaths from July 1, 1910, to January 1, 1912, he arrives at a total of 906,400 as the Jewish population of New York City in 1912.

Dr. Jacobs's study, while proceeding on apparently good statistical bases—the death-rate among the Jews as checked up by the marriage-rate and the yearly immigration figures—does not carry out its methods completely and involves a number of untested assumptions. Moreover, it arrives at an estimate hardly probable and not consistent with the changes in the Jewish population during the decade, as we know them.

A total of 906,400 for the number of Jews in New York City in 1912 is hardly plausible and well merits the epithet of the *New York Times* as "surprisingly small." It will be recalled that the "mother tongue" inquiry of two years earlier, 1910, found 861,980 who reported Yiddish or Hebrew—and that clearly underestimated the actual number of Jews. Moreover, in the decade from 1900 to 1910, the proportion of total foreign-born in the city increased over half, or 52.7 per cent. Dr. Jacobs's estimate would show an increase for the Jewish element of only 42 per cent.—clearly impossible, when we consider that the number of those born in Russia and Austria-Hungary, the lands that furnished eleven twelfths of all the Jews arriving from 1884 to 1905, increased in the same decade 145 per cent., or almost three times as fast as did the general foreign-born.

Of course, we have no record as to how many of those born in Russia and Austria-Hungary and now living in New York City are of Semitic stock, or of some branch of the Slavic peoples. But isn't it fair to assume, considering that race persecution has been one of the greatest incentives for the emigration of Jews from these lands, that the Semites have formed as large a proportion of the Russians and Austro-Hungarians as the Slavs of the total numbers coming to the port of New York in the last decade? Not to content myself with so broad an assumption, I have attempted a closer approximation from the records of the Annual Report of the Commissioner-General of Immigration as to the immigrants for the fiscal year ending June 30, 1911, "By States of Intended Residence and Race or People." Of those apparently natives of either of these two countries who declared their intention of making New York state their residence, about 47,000 were Hebrews; while, adding up the total numbers of Russians, Poles, Lithuanians, Croatians, Ruthenians, Magyars, Slovaks, and others hailing from either of the countries considered, gave a total of non-Hebrews of 51,000.

Considering that the Jew is more apt than the Slav to stay in New York City instead of seeking other sections of the state, I am fairly well supported in my assumption that, of the total additions to the population of New York City from Russia and Austria-Hungary in the last decade, the Jews probably constituted as large a proportion as the Slavic folk. Since these two countries increased their numbers in the city by 145 per cent. in the decade, does it seem that 100 per cent. for the Jewish element would be too great? That would bring up the number of Jews in New York in 1912 to somewhere between 1,100,000 to 1,200,000. Is it reasonable to assume that, while the city as a whole increased 39 per cent. in the decade, the Jewish population that had received so phenomonal an influx of new blood has increased no faster (42 per cent.), as Dr. Jacobs would have us believe?

Let us carry out Dr. Jacobs's own method more closely than he does. The death-rate of New York City decreased in the decade about 23 per cent. Assuming that the Jewish element, especially with the addition of so many in the healthy ages,

shared in the general improvement, the number of deaths per thousand should fall from 14, which Dr. Jacobs assumes for 1901, to 10.8 in 1910. This would give us an average population during the year of 1,022,700—instead of Dr. Jacobs's 825,000 for 1910. Adding his estimated increase through natural and migratory causes, of 88,100 between July 1, 1910, to January 1, 1912, we arrive by his own method at a total of 1,100,800 on January 1, 1912.

But, to my mind, the crux of the whole problem lies in the validity of the basic assumption that in 1901 the Jewish death-rate was 14 per 1,000, or 30 per cent. below that of the general population. Dr. Jacobs offers no more evidence than to say "which I fixed upon for a number of good reasons." I believe he is right in using the death-rate as probably the best basis for estimating the Jewish population, but I see no reason for assuming 14 per 1,000 in 1901 and 13.5 in 1910. I have, therefore, tried to reconstruct his estimate upon tested assumptions.

Selecting four wards of Manhattan where the Jewish element clearly predominate—the seventh, tenth, eleventh and thirteenth—all south of 14th Street and east of the Bowery, I tried to ascertain the death-rates in these wards as a clue to the probable death-rate of the Jews in the city as a whole. In 1900 the death-rates were: seventh ward, 17.3 per 1,000; tenth ward, 16.6; eleventh ward, 16.3; thirteenth ward, 14.6. Dividing the total deaths in the four wards by their combined population, I find the death-rate of the most typically Jewish section of the city to have been 16.3 per 1,000. I believe that represents very closely the death-rate of the whole Jewish population. It surely is no lower, for, if the Jews uptown and across the bridges in Brooklyn and Queens live under more healthful conditions than their brothers in these congested sections, any observer will testify to the fact that the lower East Side region, covered by wards selected, contains a larger proportion of persons in the healthy ages, recently arrived young men and women without families.

Comparing 16.3 for 1900 with the mortality of the same wards in 1910, obtained through the kindness of Dr. W. H.

Guilfoy of the New York City Department of Health, I find them as follows:

Seventh ward,	12.8
Tenth ward,	11.0
Eleventh ward,	8.6
Thirteenth ward,	9.2
Average for the four wards,	10.3

Assuming, similarly, that these wards represent approximately the mortality of the Jewish element in the whole city—say 10.5 per 1,000—my estimate of the Jews in New York City on July 1, 1910, would be close to 1,050,000. Adding to that Dr. Jacobs's estimated increase from July 1, 1910, to January 1, 1912, by net immigration and excess of births over deaths, I arrive at a total of 1,140,000 for the Jewish population of New York City on January 1, 1912—a figure neither as low as Dr. Jacobs's 906,000, nor as excessive as Dr. Laidlaw's 1,365,000.

With these two points fixed—the Jewish mortality in 1900 at 16.3 and in 1900 at 10.5—I worked backward and found that, assuming a progressive improvement in the death-rate during the decade, the rate for 1901, the year of Dr. Jacobs's first estimate, was 15.8 per 1,000. The number of Jewish deaths in that year was 11,026, which would give an average population during the year 1901 of 506, 300, or at most 510,000. It will be remembered that both Dr. Jacobs and Dr. Laidlaw agreed upon 600,000 as the Jewish population in 1901, a figure that the *New York Times* describes as "at first considered surprisingly large."

It will thus be seen that Dr. Jacobs's estimate involved a twofold error: first, in assuming for 1901 a population clearly too large by 90,000; and, secondly, in assuming 14 per 1,000 as the death-rate in 1901 and 13.5 in 1910, when a closer and more accurate study shows them to have been nearer to 15.8 and 10.5, respectively.

I prefer my own estimate of 1,140,000 for January 1, 1912, for two reasons: first, it is based upon a direct study of four typically Jewish sections of the city, surely a more reliable

basis than a guess at a death-rate; and, secondly, it shows an increase during the decade more consistent with the general increased longevity of the city and the great influx by immigration. While the death-rate of the city as a whole improved some 23 per cent. in the decade, Dr. Jacobs's estimate would reduce the Jewish mortality only 3½ per cent., in spite of the addition of persons mainly in the healthy ages. My estimate would point to a more probable and reasonable decrease in the death-rate of 34 per cent. Again, with the number of those born in Russia and Austria-Hungary—the native lands of eleven twelfths of the Jews in New York—increasing 145 per cent. in the decade, it surely is more plausible to believe that the Jewish population increased 110 per cent. in the decade, as my estimate would imply, than to accept Dr. Jacobs's increase of 42 per cent.

Attempting to bring the estimate up to 1914, it appears that the last published mortality records of New York City, by wards, are those for 1911. I have therefore resorted to the less exact, though only available, basis for estimate. In the period from July 1, 1901, to January 1, 1912, the Jewish element increased on the average 8 per cent. annually. Assuming this progressive rate of increase to have continued since, the number of Jews in New York City would rise from the 1,140,000 we obtained for January 1, 1912, to a total of 1,330,000 for January 1, 1914. I would advance the last figure, however, only as a probable approximation, until the bases for a more exact estimate become available.

REVIEWS AND NOTES.

The Influence of Monarchs. By F. A. Woods, The Macmillan Company, N. Y. 1913. $2.00.

Most scientific work necessarily consists in the slow and patient process of adding stone to stone. New foundations are put in adjacent to the old walls and it is hard to see where the work of one builder begins and that of the last leaves off.

Now and then, however, a bold spirit leaves the old structure entirely, steps out into the unknown, and traces the outlines of a new building. These are the works of real originality amid a host of routine investigations. To produce one of them is a rare achievement but Frederick Adams Woods has given us two such works within a decade. His Mental and Moral Heredity in Royalty (1906) stands alone as a comprehensive study of the inheritance of mental and moral traits; and the volume just published on The Influence of Monarchs is even more unique, since it represents the first attempt at an introduction of quantitative methods into the broader field of the history of nations.

The method which Dr. Woods has christened Historiometry consists in subjecting the facts of history "to statistical analysis by some more or less objective method." He points out in the present work how the writing of history has in the past been dominated by the subjective personal opinion of the historians and its general conclusions, therefore, failed of that "concerted agreement" which, as he says, is "the business of science." No one presumably will doubt the value of an objective statistical analysis if the data warrant it. The obvious criticism of such a method is that the raw materials upon which it works in the case of history can, in many instances, only be human opinions and these opinions might be considered too inaccurate to be capable of systematic statistical treatment. The peculiar service rendered by Dr. Woods is that, in his several investigations, he has made the experiment and obtained positive and definite results which enable him to conclude that "the judgments of historians are now proved and known to be a fair approximation to the truth." He has shown that these judgments are, within limits, reliable and that demonstrable objective conclusions may be drawn from them by the application of statistical methods.

The plan of the present work is a simple one, though like all statistical studies it must have involved very considerable labor. The material consists of the history of the fourteen principal nations of Europe for a period extending from the definite beginning of national history (between the years 987 and 1,525 in different instances) to about the end of the eighteenth century. In all 368 different reigns, regencies, or other governmental periods in these different countries form the units of study. In each case the general condition of the country is graded in three

different grades, + or − or ± according as the country showed an advance in economic and political status, a decline or a doubtful condition. The ability of the ruler for each period is graded on a similar scale. In each case the grades are assigned, not on the personal judgment of the author, but solely from an objective comparison of the statements made by a dozen historical authorities chosen beforehand for each country.

The bulk of the book consists of a summary of the material in the form of brief histories of the fourteen countries and their rulers, preceded by an Introductory chapter and by one on the Philosophy of History and Historiometry. The historical chapters are excellently done and seem to the layman to be worthy additions to history in the conventional sense. The Interpretation of the Results and a concluding chapter on Causation in History are the ones which concern us more nearly, however, from the statistical and scientific point of view.

Three hundred fifty-four cases out of the 368 studied are analyzed in the final tables. In 105 instances a superior ruler was associated with an advancing period, in 31 cases both ruler and period were doubtful, in 87 cases a weak ruler and a period of decline were associated, giving 223 cases or 63 per cent. showing complete identity. In only 11 cases was a strong ruler associated with national decline and in only 30 cases was a weak ruler associated with prosperity, giving 41 cases or less than 12 per cent. of direct conflict. The correlation between the ability of the ruler and the condition of the country works out at about .65 with a probable error of .05.

It is evident that this correlation, as compared with others which have been derived from a study of biological phenomena, is a very large one and must be considered as highly significant. The correlation in physical structure between brothers is only .50; between parents and offspring is only .40. It cannot be discredited by criticism of the sources from which the gradings were originally drawn. Their errors of judgment, if they were random errors, would only tend to lessen the correlation figure and the fact that it is obtained in spite of them shows that the records of the historians chosen must have been reasonably in accord with underlying facts. The only thing which could vitiate the results would be a constant bias, a systematic policy of magnifying the prosperity of a country under a strong monarch or of glorifying the personal ability of a monarch whose realm enjoyed unusual prosperity. Criticism on this score does not, however, seem to be justified, when one studies with care the data as to individual reigns and rulers and notes how clear and definite their characteristics are apt to be and how conservative Dr. Woods has been in assigning doubtful cases to the intermediate class.

A correlation between able rulers and prosperous national conditions might of course be due either to an influence of monarch upon national life or to an influence of national life upon the personality of the ruler. Dr. Woods advances evidence of three kinds for the former rather than the latter view. First, the transition from advance to decline, or the reverse follows in case after case immediately upon the death of a ruler.

Secondly, conditions were generally bad during regencies, or interregnums. Of such periods tabulated 36 were classed as −, and 12 as ± and 18 as +, most of the latter being associated with the personalities of powerful non-royal regents. Finally, Dr. Woods has shown in his earlier book on Mental and Moral Heredity that the personal ability of the members of the same royal families here studied, including those who did not reach the throne, was in entire accord with their ancestry and was apparently uninfluenced by their environment. The conclusion seems, therefore, clear that it was the sovereigns who controlled history, not the reverse. It should be noted that of the fourteen countries studied there is one (and only one)—which fails to show a positive correlation between ruler and national life. This is England where between 1603 and 1811 there were 10 reigns, every one marked by advancing conditions while there was only one ruler of eminence three of the intermediate and six of the minus grade. This fact suggests the warning that what was true for continental Europe in the period studied may be modified by other forces, such as we may surmise have been at work since the industrial revolution. This is only a surmise, however, like all other personal surmises, about historical causation. Dr. Woods has for the first time substituted for surmise a convincing quantitative study of the weight of one single factor, the ability of rulers, in the development of nations.

It is likely that Dr. Woods' book will only by degrees gain full recognition in the circles where it should have its most important influence. Work which lies in the beaten track of fashionable research is quickly taken advantage of but the attack on really new problems with new tools, as in the case of Mendel's discoveries, is only slowly comprehended. This is particularly the case here where the whole point of view which Dr. Woods has carried over from Biology will be strange and unfamiliar to the historian whom his work most concerns. The members of the American Statistical Association, with their scientific training on the one hand and their direct contact with the social sciences on the other, may have an unusual opportunity to interpret this notable book and the novel and fruitful methods which it exemplifies to the more orthodox historian.

C.-E. A. Winslow.

Money and Prices: A Statistical Study of Price Movements. A dissertation submitted to the faculty of the graduate school of arts and literature of the University of Chicago in candidacy for the degree of doctor of philosophy. By James Dysart Magee. Chicago: The University of Chicago. Reprinted, with additions, from the Journal of Political Economy, Vol. XXI, Nos. 8 and 9. 1913. Pp. 89.

Money and Prices is an inconclusive study based upon unreliable statistical methods.

In the words of the author the object of the study is to test "the relationship which exists between certain price changes and certain changes in amounts of money. Then the question arises of how this narrower problem is related to the discussion over the validity of the Quantity Theory of Money, which is the principal point of difference in the discussions of momentary theory at the present time. . . . Perhaps the opponents of the Quantity Theory of Money are talking about what actually happens and the adherents merely about a hypothetical state of affairs. Our problem then may be stated in alternative ways: we are attempting to find out how far the alleged proportionality does occur; or, we are attempting to find out to what extent 'other things' are not 'equal' in actual experience." (Pp. 11, 12.) In solving this problem Dr. Magee makes three classes of investigation as follows: "First a study is made of the correspondence of certain particular price movements in given markets with the movement of money or deposits in banks or money in circulation. . . . The second type of investigation concerns the relation of movements in the amount of money to the movements of wholesale prices. . . . The third type of investigation examines certain attempts at statistical proofs of the Quantity Theory of Money. These proofs make allowances for the factors omitted from what we have called the crude theory." (Pp. 12–15.)

The statistical method used by Dr. Magee in making his tests was explained in his article on "The degree of correspondence between two series of index numbers" in the QUARTERLY PUBLICATIONS for June, 1912. In that article he objects to the use of the Pearsonian coefficient of correlation as a means of testing the relationship between two series of index numbers because (1) "it entirely disregards the element of time which in most problems in which index numbers are used, is of prime importance"; and (2) "a given quantity may be added to or subtracted from the terms of our series without changing the value of the correlation coefficient."

The first objection does not hold if we use Mr. R. H. Hooker's method of computing the correlation coefficient from the "differences between successive values of the two variables." ("On the correlation of successive observations," Journ. Roy. Stat. Soc., Vol. 68, p. 697; see also the reviewer's "The correlation of economic statistics," QUARTERLY PUBLICATIONS OF THE AMERICAN STATISTICAL ASSOCIATION, December, 1910.) Con-

cerning this method Mr. Hooker says that "correlation of the difference between successive values will probably prove most useful where the similarity of the shorter rapid changes (with no apparent periodicity) are the subject of the investigation, or where the normal level of one or both series of observations does not remain constant." (*Ibid.*, p. 703.) G. Udny Yule uses Hooker's method of differences in measuring the correlation between the annual infantile mortality per 1,000 births and general mortality per 1,000 living. (See Yule's Theory of Statistics, p. 197.) The method of differences accomplishes two results: (1) it reduces, although it does not entirely eliminate, the influence of the growth element on the coefficient; and (2) it has the effect of making the *order in time* of the items of significance.

Dr. Magee's second objection to the coefficient of correlation as stated above calls attention to a virtue, not a defect, of the coefficient. That "the correlation coefficient of two series of index numbers is not changed if we add a constant to each term of one series" is true. But that this fact "is perhaps the strongest argument against using it for testing the relationship between two sets of index numbers" is decidedly untrue. Suppose that we are using the ordinary graphic method of comparing the fluctuations of two series of index numbers, each series represented by a graph with time as abscissas. If the ordinates are such that one graph is so far below the other that comparison is difficult we shift the former upward or the latter downward for convenience in comparing the fluctuations. This graphic process is identical with the algebraic process of adding or subtracting a constant to or from, as the case may be, each term of the series. It may be said, indeed, that any method of measuring correlation which does not have the mathematical property to which Dr. Magee objects is erroneous.

As a substitute for the coefficient of correlation the author suggests that the two series be treated as follows: First, multiply each item of one of the two series by such a multiplier as to make the initial items of the two series identical. "Next," he says, "we may get the amount of change in each case and take as the degree of correspondence the fraction which has the smaller change for the numerator and the larger change for the denominator. . . . By treating each successive change in this manner and then taking the arithmetic mean of the results we obtain what may be called the Degree of Correspondence. . . ." Thus, in comparing the two series: 2, 4, 6, 8, 10 and 5, 10, 15, 20, 25, Dr. Magee would multiply the items of the first series by 5-2, obtaining a series identical (in this case) with the second series. For this pair of series the fractions are all 1 and the arithmetic mean of the fractions, or the "Degree of Correspondence," is therefore 1.

The author uses this method throughout his investigation to test the relationship between weekly, monthly, and yearly, (1) price indices for bonds, stocks, farm products, certain speculative commodities, and wholesale prices of commodities on the one hand, and (2) specie and legal tenders in the New York clearing house banks, net deposits, and per

capita and total circulation on the other hand. Finally, he applies the same method to the figures obtained by Kemmerer and Fisher as his (Dr. Magee's) test of the truth of the quantity theory of prices. As a matter of fact, however, in more than nine tenths of the cases the author was contented to take +1 in case the changes of the corresponding items were in the same direction, and —1 in case they were in opposite directions, giving the arithmetic average of the algebraic sum as his "Degree of Correlation." Out of some 114 tests the resulting average was below 0.10 in 46 cases, from 0.10 to 0.19 in 42 cases, from 0.20 to 0.49 in 21 cases, and from 0.50 up in 5 cases. *It is noteworthy that all of the five cases of a high "Degree of Correspondence" came from comparing yearly figures where the growth element predominates.* In the words of the author "the correspondence is greater between price movements and the movement of money or deposits in banks or of money in circulation when the averages used cover longer periods than when they cover shorter periods." (P. 54.) He does not appear to recognize, however, that like growth elements in the two series make his "Degree of Correspondence" unreliable as a measure of the synchronization of fluctuations. (See the table given later.)

The application of the test to Kemmerer's and Fisher's figures leads Dr. Magee to the conclusion that "in neither case is much correspondence shown for direction and amount of movement; our inference is, then, that these two attempted proofs of the Quantity Theory of Money are far from being conclusive." (P. 49.) Before taking the author's word for the non-conclusive character of the Kemmerer and Fisher investigations let us see how his method works in sample cases.

Suppose the method be applied to the following pair of series:

100,	150,	200,	250,	300
100,	200,	300,	400,	500

Both series are arithmetic progressions and move in the same direction. The "Degree of Correspondence" is ½. Now consider the pair of series below:

100,	101,	102,	103,	104,	105
100,	110,	120,	130,	140,	150

The "Degree of Correspondence" is but 1-10, although the items move together perfectly, *i. e.*, for an increase of one unit in the first series there is an increase of ten units in the second series. Likewise consider the *following* pair:

100,	101,	102,	101,	103,	100
100,	105,	110,	105,	115,	100

These series fluctuate together perfectly, *i. e.*, for a change of one unit in the first series the second changes five units in the same direction. Yet Dr. Magee's "Degree of Correspondence" for the pair is only 1-5. It is evident that any coefficient is possible for perfect correspondence. Dr. Magee's entire study is based upon this erratic coefficient.

The reviewer will add the following table:

Magee's method of "Degree of Correspondence" applied to a pair of series having the same direction of growth element, *e. g.*, series giving the relative per capita money in circulation on July 1, and the relative per capita consumption of malt liquors in the United States, 1890–1908.

(Statistical Abstract of the United States, 1909, Folder p. 19.)

Year.	Index of money in circulation.*	Index of consumption of malt liquors.†	Correspondence.		
			+	—	0
1890	90	90			
1891	93	97	.43		
1892	97	100	.75		
1893	95	106		.33	
1894	97	101		.40	
1895	92	99	.40		
1896	84	104		.62	
1897	90	98		1.00	
1898	99	105	.78		
1899	101	101		.50	
1900	106	105	.80		
1901	111	106	.20		
1902	112	115	.11		
1903	116	118	.75		
1904	122	120	.33		
1905	123	121	1.00		
1906	127	132	.36		
1907	127	139			0
1908	137	138		.10	
Totals			+5.91	—2.95	0

* Base, 1890–'99. All items multiplied by 0.9375, making the initial item identical with that of the second series.

† Base, 1890–'99.

"Degree of Correspondence," 1890–1908=(5.91—2.95)÷18=0.16.

"Degree of Correspondence," 1899–1908=(3.55—0.60)÷10=0.295.

"Degree of Correspondence," considering only the direction of the change for the period 1899–1908=(7—2+0)÷10=0.50.

For the ten years, 1899–1908, the "Degree of Correspondence," as Dr. Magee would figure it, between per capita money in circulation and per capita consumption of malt liquors is very high, 0.50. Does this indicate that the circulation is increased by drinking alcoholic beverages, or *vice versa?*

WARREN M. PERSONS.

Colorado College.

URUGUAYAN STATISTICAL REFORM.

[American Minister Nicolay A. Grevstad, Montevideo.]

The General Council of Statistics has taken steps to bring about an important reform of the commercial statistics of the Republic. Hitherto the import and export values have been based upon prices fixed, in many instances years ago, for fiscal purposes. These prices no longer represent the real value of the articles imported or exported; they are either too high or too low, generally too low. The council intends to base the statistics, beginning with the current year, upon the real values, as near as possible, and to that end solicits the coöperation of leading importers and exporters. This reform is held to be necessary in order that Uruguay may, in the comparative commercial statistics of the world, occupy the place to which it is justly entitled by the volume and value of its commerce.

F. L. H.

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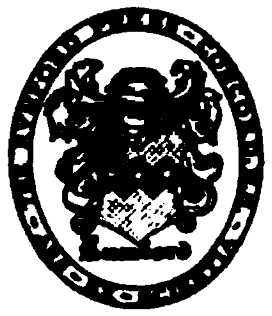

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AMERICAN
STATISTICAL ASSOCIATION

NEW SERIES, No. 106. JUNE, 1914.

THE PRESENT STATUS OF STATISTICAL WORK AND HOW IT NEEDS TO BE DEVELOPED IN THE SERVICE OF THE FEDERAL GOVERNMENT.*

By William S. Rossiter, *Former Chief Clerk of the Census Office.*

I assume that we are invited to discuss the present condition of Federal statistics and to point out, if possible, the pathway along which real progress can be made.

When this association was formed, the Fourth Census, that of 1830, had long been completed. There was practically no statistical analysis or inquiry of any kind in progress under the Federal Government. At this distance, the temporary organizations of the early Census offices seem to us to have assembled from nowhere, performed with zeal if not with discretion their appointed tasks, left us their records in awkward or musty tomes and vanished into oblivion. Like the gleam which pierces the night at regular intervals from some distant lighthouse on a rock bound coast, were those far away Census enumerations.

It is different in our day; the gleam from the Census lighthouse is no longer of the disappearing variety. There are, moreover, many other prominent statistical lights in the Federal establishment. So great has been the progress, and so general has become the necessity for statistical compilations, that, in the year 1914, practically every department of the Federal Government is engaged in preparing statistics in some form.

In the Department of Commerce, practically all the bureaus obtain and publish more or less statistical material. Among these that of the Census easily leads. It possesses a dozen intercensal activities, in the aggregate almost equal in impor-

* Paper read at the Seventy-fifth Anniversary Meeting of the American Statistical Association, Boston, Mass., February 14, 1914.

tance to the decennial enumeration. The Bureau of Corporations discusses investigations of data relating to trusts and similar organizations. The Bureau of Foreign and Domestic Commerce deals with the statistics of exports and imports and summarizes much of the statistical investigation of the Government in the annual Statistical Abstract. The Bureau of Fisheries presents the statistics of that industry. The Bureau of Navigation, figures relating to the merchant marine and wireless telegraphy. The Steam Inspection Service, figures in relation to steamboat inspection and marine accidents.

In the Department of Labor, the Bureau of Labor Statistics compiles and publishes figures of strikes, wages and labor, and certain special reports such as those upon cost of living. The Bureaus of Immigration and of Naturalization discuss the statistics relating to those important subjects. The Children's Bureau compiles figures relating to infant mortality and child saving.

In the Treasury Department, the Life Saving Service collects and publishes the statistics of marine disasters. From the Commissioner of Internal Revenue come figures relating to the production of liquors, tobacco, etc., and this report will soon include the income tax returns. The Director of the Mint presents annually statistics of the production of the precious metals. The Comptroller of the Currency and the Treasurer of the United States offer financial and banking statistics. The Register of the Treasury compiles and publishes the debt statement.

In the Department of the Interior, five bureaus present annual statistical tabulations; the Bureau of Mines, regarding fatalities in coal mines. The Commissioner of Indian Affairs presents statistics of Indians and Indian lands and property. The Geological Survey compiles and publishes extensive statistics of mines and quarries, and mineral products. The Commissioner of Pensions tabulates the returns of pensions paid and the number and location of pensioners. The Commissioner of Education publishes statistics concerning the number and character of schools and concerning school population.

The Department of Agriculture, through its Bureau of Sta-

tistics, is engaged in collecting and publishing reports of cereals and other crops, and also publishes special reports relating to various agricultural products.

The Forest Service publishes statistics of lumber cut and forested areas.

The Weather Bureau publishes figures relating to temperatures and meterological data.

The War, Navy, and Post Office Departments make their contribution to the statistics of the Federal Government. The Signal Corps of the War Department compiles statistics of Government telegraphs and telephones. The Navy Department compiles and publishes important tables dealing with the naval establishment of the United States and the naval militia of the various states. The Post Office Department publishes statistics of post offices, postal routes, and the railway mail service.

The Civil Service Commission compiles statistical tables relating to employment under the Federal government.

And last, but not least, that young giant in the field of Government offices, the Interstate Commerce Commission, now has large divisions engaged in collecting important statistics of express companies, steam railways and telegraphs and telephones.

From this survey you will observe that every department of the Government except the Department of Justice, is actively engaged in compiling some form of statistics. Some of these statistics, however, are what we may term of the negative sort, viz., they are the details of the operations of the department itself; but for the most part they are compilations of new and useful data, made by twenty-nine different bureaus at Washington.

It is difficult to indicate clearly the aggregate number of persons engaged in these compilations, part of which obviously are not continuous. In the Bureau of the Census at Washington are approximately 700 permanent employees, in addition to 700 agents employed in the field to collect cotton statistics. The Decennial and Five Year Censuses require additional force; the bureau of Statistics in the Department of Agriculture employs somewhat less than 200;

the Bureau of Labor statistics in the Department of Labor, approximately 100; the Bureau of Mineral Resources in the Geological Survey about 40; and the Bureau of Foreign and Domestic Commerce somewhat more than 100. Here are nearly 1,200 permanent employees of the government engaged in statistical work in five bureaus of the twenty-nine.

Of all these bureaus we naturally are most interested in that of the Census, the principal collector and compiler of Federal statistics. Moreover, it has been justly claimed that this Association was an important factor in securing the establishment, a decade ago, of the Permanent Census Office. In the last issue of the QUARTERLY of this Association, Doctor Cummings presented an effective review of the operations of the bureau, and described its many and varied activities, but to those of us who participated in its establishment and have watched its progress, there seem to be many things yet to be desired.

The Permanent Census Office was formed from a temporary organization which was unique in its independence of bureaucratic control. The superb achievement of the Director of the Twelfth Census in organizing a temporary bureau, by bringing together experts from all parts of the country, gathering together those who knew from past experience and those who did not know, welding them into a harmonious and enthusiastic whole, and in taking, compiling, and publishing a great decennial census absolutely within the time limit set by law, was an achievement which had not been equalled before, and which, unfortunately, still stands unparalleled. This supreme result was secured primarily because of one central fact: the Director of the Twelfth Census was absolutely independent of every one in the Federal Government except the President of the United States. The truth of the comment which Colonel Goethals sent to the Mayor of New York a fortnight ago, concerning the importance of complete authority is well illustrated by the record of the Twelfth Census. His words are merely a plea for full authority: "Attractive as your offer is, I would be obliged to decline it so long as the present law remains in force by which removals from the police force are subject to review, with decisions based on legal evidence.

In public work of any kind, efficiency can be secured only when the service of those engaged in it is satisfactory to superiors, and while I fully believe in the right of every man to have a hearing, the decision of the superior as to the character of a man's service should be final. In cases," adds Colonel Goethals, "where a man whose services have not been satisfactory can be reinstated by a court of review, the effect on discipline and efficiency is most injurious. It undermines authority, leads to insubordination, tends to destroy the loyal coöperation which the executive authority must have to secure results, and makes his tenure of office impossible."

The taking of the Twelfth Census had been entrusted to a man who shirked no responsibility and possessed untiring energy. It is not surprising that in the preparation and publication of the basic facts of the Census it was a complete success. The Director of the Census made his own appointments; he was unhampered by Cabinet officers, by Civil Service, by department bureaucrats, or by Congress. He drew his employees from north, south, east and west, as he thought best. He expended the vast sum of money appropriated in a lump sum to his order as in his judgment it was advisable. He established the character of the tables and the form of presentation and held his subordinates responsible for prompt production. Even in the printing of his reports, he was not a victim of the Government Printing Office in the ordinary sense, but an independent customer, for he ordered his work produced, scrutinized the bills, complained of overcharges and paid just accounts with his own check upon the Treasury of the United States. There were doubtless defects here and there through that vast system, but it was a one-man power, as it ought to be, and the work was driven forward to splendid completion.

It was this office and this sort of a policy that the permanent office succeeded. The wiser and older members of the Senate and House of Representatives, having learned their lessons from earlier Census experience, realized the need of the one-man power in the Census office, so fraught with emergencies, and they strove to perpetuate in the permanent establishment the favorable conditions prevailing in the temporary office.

Moreover, the Director of the Census who succeeded the Director of the Twelfth Census, fully alive to the importance of maintaining the same independent, aggressive attitude, strove during his entire administration to hold the standing and the prerogative of the Census Office as separate, unique, and to some degree independent of the department. For several years, with varying success, the contest was waged between the Census Office aided by Congress, on the one side, and the bureaucrats of the department on the other, aided by tradition, precedent, and administration politics. The result of the contest was of course not in doubt from the outset. Ultimately the department and politics triumphed and the secret of the failure of the Thirteenth Census to measure up to the temporary Twelfth Census in effectiveness and speed lay in the return to the old bureaucratic methods which had paralyzed and destroyed the activities of the Eleventh and earlier Censuses. All of the small but necessary acts of administration, including those of appointment, promotion, demotion, and dismissal, hung upon the say so of some petty department clerk or official and every time that a minor question of administration on which a Census chief ought to be able to act instantly and emphatically, went to the Department, a mile away, by letter or by telephone, to be bandied about in various divisions, a distinct blow was struck at the authority of the chief and at the enthusiasm and interest of the clerks.

The permanent Census Office contemplated by Colonel Wright, by Mr. Porter, by Professor Willcox, Doctor North, and Governor Merriam, as they pleaded before the Committees of both Houses of Congress for its establishment, was to be an institution fashioned from and preserving the strong, sturdy, and splendidly successful office then in existence. But the Permanent Census Office has actually resulted in a very different affair. In fact it bears only a shadow of resemblance to the organization of a decade ago. The Census Office has in truth become the Bureau of the Census. No unkindly criticism of individuals is here intended. It would be entirely unwarranted. The change here described reflects the conditions which prevail in the Federal

Government, and which, so far as the chances of a single permanent bureau are concerned, cannot be changed. In short, when the strong, lusty temporary office was made into a permanent office, it sacrificed certain important characteristics in return for this privilege. Curiously enough, the distinguished men who advocated the permanent office seem not to have anticipated this result, yet the personal experience of each with the Federal Government had been so extensive that the power of precedent and the eddies of official influence and intrigue ought to have been fully understood and provided for.

Thus far, in our review of federal statistical operations, we seem to have fallen upon two obvious defects, the growth of statistical activity in twenty-nine branches of the Government with the inevitable penalty of wastefulness and duplication, and the sacrifice of some of the independence and authority of the Census Bureau, and hence, in that distinctly emergency-ridden office, the loss of a good share of efficiency,—in return for permanence. Doubtless there are many defects in federal statistical methods, but the two here described are basic in that they reflect federal policy and practice and they will continue to become more serious. I invite your attention therefore to a brief search for a possible remedy.

At the outset, it is important to inquire, whether the two conditions here indicated are equally prominent in the statistical operations of the more important foreign nations.

In Canada, where the science of statistics has become increasingly important to the officials of the Dominion Government, the statistical establishment at the present time is the result of the reorganization which occurred in 1905. In that year the Federal Parliament established the present Census and Statistical Office as a branch of the Department of Agriculture, and charged this office with three general functions:

The Decennial Census to be made in the first year of the Decade, 1911, etc.,

The taking of a mid-censal year census of population and agriculture for the three Northwestern Provinces, and

The prosecution of special intercensal statistical inquiries ordered from time to time by the Minister. These orders

may cover the collection, tabulation, and publication of statistics relating to agriculture, commerce, crime, education, manufactures, vital, and other statistics.

The Census and Statistical office of the Dominion is conducted by a chief officer and three principal assistants, and has a permanent clerical staff of twenty-five, and temporary clerks not to exceed one hundred and seventy. In a general way, conditions in the Dominion reflect on a small scale those which prevail on a large scale in Washington.

The Canadians, however, are not satisfied with the present status of statistical organization in their Government, and in 1912 the Minister of Trade and Commerce appointed a commission to examine into this whole question in order to report a comprehensive system of general statistics in keeping with the demands of the time. This report has already been published and makes many suggestions for improvement, the principal one being the advocacy of a central statistical office for the coördination, unification, and improvement of statistics, the creation of an interdepartmental statistical committee and an inter-provincial conference on statistics. The adoption of many of the suggestions of this commission would obviously mean a great advance for the Dominion of Canada in its statistical organization and product.

In Austria there is a central statistical commission. The work of this Imperial Commission falls into eight divisions:

1. International Statistics.
2. Those of Commerce, the Year Book, and other publications.
3. Of Agriculture.
4. Of societies, corporations, banks, and transportation.
5. Of finance.
6. Judicial statistics.
7. Statistics of Education.
8. Vital statistics.

Several of the Ministries of the Imperial Government prepare some statistical analysis of their own and aid to some extent the Central Commission. Several of the Provinces also maintain statistical offices, but these act in coöperation with the Central Commission supplying it with material.

The Central Commission has existed since 1863 and possesses an exceedingly competent staff.

In Germany, the Imperial Statistical Office has supreme charge of the periodical census and publishes financial, judicial, vital statistics, etc., for the Empire. In a sense, it acts as a clearing house for the other statistical offices which supply the Imperial Office with a large amount of the material used in presenting statistics for the Empire. Each kingdom and principality maintains a separate statistical office concerned with that part of the work of the Empire, which it represents. In addition there are various local statistical bureaus which coöperate in different ways with the Central Office of the Kingdom.

In France, a Central Statistical Office takes the periodical census and its activities embrace not only the collection of population statistics in the entire nation, but a variety of subjects. It works however in full coöperation with the various municipal offices.

In Italy, a Central Statistical Office exists similar to that of France. In Russia, an Imperial Statistical Commission covers the Empire, but it is mostly concerned with the statistics of commerce and finance. In Finland, indeed, which maintains an independent statistical office, the organization and operation of the Bureau is more effective and scientific.

In England, the Registrar General publishes the judicial and vital statistics of the nation, and also has charge of the enumeration of population. Separate from this office is the important statistical machinery of the Board of Trade, having seventeen departments which deal with the statistics of commerce, finance, and similar topics.

All of the smaller countries of Europe now have Central Statistical Offices with permanent and scientifically trained staffs. Those of Sweden, Norway, Holland, Belgium, and Switzerland are highly developed. In all cases where there are municipal and statistical departments in these countries they act as feeders and aids to the Central Office. In short, in Europe and in Canada, progress in the science of statistics appears to be secured by centralization of work, under the most expert direction.

In none of these nations, however, do the problems in the field of statistics approach in importance those which exist in the United States. We have long been regarded as a leader in the development of the science. We have hesitated at no inquiry, we have been deterred by no expense, and we have boasted accordingly. Meantime, other nations, growing slowly and modestly in their statistical operations, have been perfecting their organization in deliberate and substantial fashion. Statesmen as well as statisticians seem in almost all instances to have become impressed with the distinctly scientific character of statistical investigation. In rare instances only have our American presidents and politicians taken that point of view.

With the distinct impression that real progress in statistical work is being made in other lands, accompanied or secured by increasing centralization, we return to the two serious problems in the statistical work of our own Government. These problems appear in a broad way to originate in decreased authority and decentralization, tendencies directly opposite to those shown by statistical progress elsewhere. So significant is this fact that we are justified in asking whether the solution of our problems is not to be found in a reversal of policy. Should we not create an important statistical center in our federal government, which we may here simply term The Office of National Statistics? This new office, to be erected from various small bureaus, ought to be in the semi-independent class, with the Interstate Commerce Commission, the Civil Service, and the Government Printing Office. It should be free from the Department Bureau curse. By its importance and form of organization it should reassume the authority possessed by the temporary Census and lost after securing permanence. It should take over, simplify, and coördinate the more important and expensive statistical work now being performed and often more or less in duplicate by the twenty-nine Bureaus. Lastly, such a large dignified systematic statistical establishment should be wholly scientific, with no trace of politics, should be conducted by a distinguished scientist and administrator with competent aids and complete authority.

I do not suggest a cabinet office to represent this modern

science of ours. It requires no such doubtful honor. All that we of this venerable association demand is better organization and administration, which permit full authority and prompt and scientific results secured without extravagance.

The proposed Office of National Statistics might profitably include at least the following:

The Decennial Census.

Miscellaneous inquiries involving census investigation, such as now supply the intercensal activities of the Bureau.

The present Bureau of Statistics.

Labor statistics.

Statistics of mines and quarries of the Geological Survey.

Statistics of foreign and domestic commerce.

Statistics of the express companies, railways, telephones and telegraphs now collected by the Interstate Commerce Commission.

The statistical work of the Forest Service, of the Agriculture Department, and of the Bureaus of Immigration and of Fisheries.

If wisely administered, measureless are the opportunities of such an office for usefulness, in effectively collecting and compiling the necessary statistics of the Federal Government. Here should be given the time and skill of experts to insure the avoidance of duplication and especially to consideration of the pressing need of simplification. In a decade or two, much of our present Census elaboration, of necessity, will be swept away by mere weight of population. We should begin the study of this problem now.

The present Bureau of the Census has been called frequently a statistical laboratory. Except during a few brief intervals this name has not been justified. A laboratory is a place for analysis and original research, where great discoveries in the scientific world are worked out. The Bureau of the Census may be more correctly called a figure factory. It has tabulated an infinite variety of statistical facts, but it seldom offers anything but raw material.

In the past I have pleaded for a real statistical laboratory in the Bureau of the Census; for an analysis by experts who could take the figures from this or that inquiry and make them tell the story of American life, revealing the changes

which have occurred and pointing unerringly to the changes which are to come. In my opinion, that is the highest scientific function of the Census Office, and in any new and enlarged statistical organization that function should be given great prominence.

Let us not be contented with the creation of a permanent Census Bureau as the great achievement of our three score years and fifteen, a bureau which to the privilege of permanence has sacrificed much of its independence, but let us resolve that so vast have become the statistical activities of the Federal Government that they now demand complete reorganization along the most scientific and progressive lines.

In view of the recent action of our neighbor, Canada, struggling to reform and concentrate her comparativly small statistical activities, and particularly in view of the general movement of the civilized nations toward centralization and toward more effective presentation of statistical material, it is not too much to say that it is time for the United States to bestir herself or abandon her claim to leadership in the science. We should insist on the omission of superflous detail. We should urge more rigid economy, we should punish costly errors, such for example as the Thirteenth Census report on mines which cost hundreds of thousands of dollars and really offered little more than a duplication of figures already published by the Geological Survey. We should insist always upon accurate and prompt production of reports and tables with penalties for failures.

In short, I urge that the goal of this Association in the future should be the creation of a permanent independent central office, to collect, compile, and publish simplified census and other important Federal statistics. With this achievement should come retention of officials who prove to be conspicuously successful, utterly regardless of political affiliations. And, finally, there should here be found in fact as well as in theory, a great statistical laboratory which shall place the United States at the head of the civilized nations in scientific, statistical analysis, and which shall be continually telling the vast, ever-increasing but ever-changing multitudes of old and new Americans whence they came, what they are accomplishing, and whither they tend.

PRESENT STATUS OF STATISTICAL WORK AND HOW IT NEEDS TO BE DEVELOPED IN THE SERVICE OF THE STATES.*

BY ADNA F. WEBER, *Chief Statistician of New York Public Service Commission for the First District.*

It would be easy and perhaps natural to draw misleading inferences from a merely superficial examination of the available statistics descriptive of the status and progress of civilization in the several commonwealths of the United States. Much of the material is widely scattered and might not be discovered by the casual inquirer. Certain information could be found only in Federal reports; additional information is hidden away in departmental reports and seldom cited in bibliographies, and still other data are published only in legislative documents that go to a very small number of libraries and consequently escape the notice of all but a few special students or investigators. And yet so abundant is the statistical material in many of the more important commonwealths, that a competent investigator or compiler would find no serious difficulty in preparing a statistical abstract that would at least equal in extent and comprehensiveness, if not in accuracy, the statistical year-book of the German Empire or other manuals that are as favorably known. The researches of the Carnegie Institution have brought to light the great mass of economic materials existent in the public documents of commonwealths like New York and other Eastern states.† This material, gathered by the state departments and commissions and by legislative investigating committees, is almost as abundant if not so valuable as that contained in the British bluebooks,—the remarkable series of historical documents that justified Gustav Schmoller of the German historical school of economists in ranking England as one of the leaders of his school of thought. While important investigations are

* Paper presented at the seventy-fifth anniversary meeting of the American Statistical Association, Boston, Mass., February 14, 1914.

† Index of Economic Material in Documents of the States of the United States: New York, 1789-1904. Prepared by Adelaide R. Hasse, 1907.

not likely to escape the attention of the journals of the Statistical and Economic Associations, it remains true that much valuable work is not fully utilized or appreciated, because it remains unknown. Even the index of reports of bureaus of labor prepared and published by the Federal Bureau in 1892 and 1902 has been discontinued.

The most obvious if not the most important need of statistical work in the commonwealths would therefore seem to be a central bureau of statistics and information to collate and compile the statistical information already available, but at present more or less inaccessible. A step in the direction of a commonwealth statistical abstract may perhaps be recognized in the Legislative Manual prepared by the Secretary of the State or other officer for the use of the members of the Legislature and other state officials. Such a manual usually contains statistics of population, wealth (for purposes of taxation), and elections, and might readily be expanded so as to be made a complete statistical year-book, which would embody the final results of statistical research of the several state authorities, and also of the Federal bureaus so far as needed to supplement state activities. The movement toward such a central office of compilation and coördination must be initiated by the learned societies, libraries, and educational institutions, representing the individual consumers of the product. The legislature itself can command information on a special subject from the appropriate state department, and where such information is insufficient, can initiate a special inquiry of its own and for that reason can hardly be expected to take the necessary action unless pressed to it by public opinion.

This conception of a state bureau of statistics differs from the European idea of a central bureau in which is concentrated a large part of the statistical work of the state. The European idea does not commend itself to Americans, who believe that statistics of a special field should be prepared by the authority constituted to supervise that particular field. But it can hardly be doubted that a well organized and equipped office in charge of a general statistical abstract would have a stimulating effect upon the statistical work of the several

state departments. Above all, it would reveal the most serious gaps that might exist in the more general statistical information of the individual states.

A survey of the statistical activities of some of the principal commonwealths indicates that large portions of the field of economic statistics are already well cultivated. In Massachusetts, New York, Wisconsin, and other states we find much progress in the statistics of manufactures, mining, transportation, banking, and insurance. In the field of social statistics we also find much of encouragement in the work of departments of education, health, and charities, including hospitals for the insane. In all of these departments there are now to be found statistical offices that offer permanent careers to trained civil servants. The rapid spread of the movement for workmen's compensation acts also promises needed development in the long neglected field of industrial accidents and diseases.

But in most of the states of smaller resources, statistical work is still in a backward condition, and the same statement applies to certain of the states of large resources. Civil service reform has not yet taken root in all of the commonwealths and needs now, as much as it ever has needed, the support of members of the Statistical Association and other citizens interested in good statistical work. Permanency of tenure for civil servants seems to me perhaps the greatest single need of the states in the development of good statistical work as of other technical work. When we examine conditions underlying the statistical output of a leading state like Massachusetts, we are likely to find the largest single factor to be the long-continued service of bureau or division chiefs. These men may have entered the service without having qualified in competitive examinations, but they have retained their positions through successive administrations despite party changes and have acquired in office the necessary statistical training. To insist upon extensive statistical training as a prerequisite to employment in the statistical service does not seem to me to be necessary. While I have always favored a high standard of education and have in fact sometimes endeavored to set the standard as regards scholastic attain-

ments higher than the Civil Service Commission was willing to establish it, I have always sought to obtain men who had had indeed a good academic training, especially in economics, but had also demonstrated their ability to do original work, whether in statistics or any other field. A very considerable number of young men who entered the civil service of New York through such examinations in the past fifteen years now hold responsible positions in the statistical offices of the various state departments or of private corporations. It may be of interest incidentally to note that in this period the average salary of a statistician in the state service has increased 30 or 40 per cent. The time seems to be near at hand when the statistical service can offer as attractive inducements to young men of promise as does the law or engineering. This is especially true of work that combines accounting with statistics, for such a combination of experience is coming to be highly appreciated by the large corporations.

The movement for "efficiency and economy" in public business may be explained in part as an outgrowth of the efficiency engineering idea developed in private business, but it owes its origin in part at least to the work of organizations like the Bureau of Municipal Research, which is carried on by investigators trained in statistical as well as accounting methods. The movement is therefore to be recognized as one that should react favorably upon the statistical work of the commonwealths relating not to the transaction of public business (*e. g.*, the "budget") but to the recording of social and industrial phenomena of the entire body politic.

If accountancy is to be regarded as a branch of statistics, we must also grant recognition to the statistical work done by engineers, not only in the development of business efficiency but also in the development of public policy concerned with public service corporations. In the past decade, engineering firms have been called upon to make exhaustive studies of the street railway situation in several of our large cities and in their reports they have to a large extent applied the statistical method. An excellent example of such statistical work is afforded in the recent report of the Rapid Transit Commissioner of the City of Philadelphia. If work of like character has not

already been done for commonwealth governments, it may be looked for as a development of the early future. The need for special investigations of broader scope than those carried on by permanent bureaus or departments will from time to time bring about the establishment of special commissions that will require expert investigators, and it will be the duty of members of the Statistical Association to use their influence in favor of the adoption of the best methods of investigation on the part of such commissions. Three recent New York reports—on Industrial Accidents, Unemployment, and Factories—are excellent illustrations of the results that may be achieved by the combination of the regular staff of state bureaus and a staff of special investigators temporarily employed by the commissions. Such results would not have been attained had not members of this Association and similar societies, like the Economic Association and the Association for Labor Legislation, taken an active part in the movement for the establishment and organization of the commissions.

In the next few years there will in all probability be movements started in the different commonwealths for the reorganization of state departments which carry on more or less statistical work, and the statistical societies, it seems to me, should at such times coöperate actively with the profession most directly interested in such reorganizations. The New York City branch of the Association at a recent meeting voted to memorialize the city government in favor of the adoption of the recommendations of a special committee of medical men for a reorganization of the department of health, designed, among other things, to secure an improved system of registration of vital statistics. The lawyers in many states are now actively supporting a revision of judicial procedure, including among other things, better records of crimes and torts. The defects of our judicial statistics are nearly everywhere so serious that a reform movement of this kind should also enlist the coöperation of members of the statistical society.

It seems unnecessary to continue further in the enumeration of the special subjects that most need improved statistical methods. It should suffice to refer to the continued existence of a need, in the commonwealths as elsewhere, for the occa-

sional special commission as well as the permanent bureau, and the interdependence of the one upon the other. If the special commission can obtain from the permanent bureau statistical material of a high degree of accuracy and comprehensiveness, it will be able to carry its pioneer work along new lines so much the farther. And the higher its achievements in advancing the limits of our knowledge, the greater will be the effort of the permanent bureau to hold and maintain the advantage.

STATISTICS IN THE SERVICE OF THE MUNICIPALITY.*

By F. Spencer Baldwin, Ph. D., *Professor of Economics, Boston University.*

It would be superfluous to take the time of this audience for an extended preliminary dissertation upon the need of applying statistical methods to the study of municipal conditions and activities. The members of this Association do not need to be told that the rapidly increasing concentration of population in large cities, the alarming growth of municipal expenditures and indebtedness, and the widespread prevalence of inefficiency, wastefulness, and corruption in the government of American municipalities constitute a problem of the first magnitude for American democracy.

At the present time about one third of the total population of the United States is found in cities of over 30,000 inhabitants. The total governmental costs of the 195 cities of this size amount to nearly one billion dollars, as contrasted with expenditures of roundly six hundred and fifty million dollars by the National government, and less than two hundred million dollars by the state governments. The total indebtedness of these cities approaches closely to the three billion dollar mark, or sixty-nine dollars per capita, as against one billion dollars indebtedness, or eleven dollars per capita, for the National government. Moreover, population, expenditures, and indebtedness are all increasing in the cities at a much faster pace than for the nation at large. These figures emphasize sharply the urgency of careful statistical inquiry into the conditions created by municipal expansion.

I shall discuss this subject from the point of view of American conditions and experience, with special reference to the city of Boston. It may not be inappropriate in this connection to remind the members of this Association that Boston has led the way and set the pace in the development of statistical

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service in American municipalities. The first adequate and scientific city census taken in this country was the Boston census for the year 1845, taken under the direction of Mr. Lemuel Shattuck, one of the founders of this Association, who introduced new and improved methods of enumeration and tabulation. His report, published in 1846, is a genuine statistical classic. This Boston census of 1845 was confessedly so superior to any previous census that Mr. Shattuck's advice and assistance were sought by the United States Census Board in 1849, in preparing the schedules for the seventh census of 1850. Five of the six schedules used in that census were designed and prepared principally by Mr. Shattuck. Thus, in certain important respects, the city of Boston showed the Commonwealth of Massachusetts and the United States how to take a census.

I may, perhaps, be pardoned for mentioning here the further fact that Boston was the first city in this country to establish a municipal statistical department. The Boston Department of Municipal Statistics was created in 1897, at the instance of Mayor Josiah Quincy. It was designed to serve as a non-political scientific bureau, for the compilation and publication of municipal statistics, and it has been consistently maintained on this plan, notwithstanding assaults by unappreciative or apprehensive politicians. This, I submit, is an achievement of no mean order, especially in view of the failure to maintain similar departments established in New York, Chicago, and Baltimore.

In considering the question of what service statistics can render to the municipalities, it will be well first to review what has already been done in this field, and then to inquire into the possibilities of further extension and improvement of the work. The development of municipal statistics in this country has followed four main lines:

1. Collection and publication of financial statistics of cities by the National government;

2. Investigation and supervision of municipal finances by State governments;

3. Compilation and publication of financial and social statistics of cities by municipal departments of statistics;

4. Inquiry into municipal departments and conditions by bureaus of research under private management.

1. A beginning was made in the collection and publication of municipal statistics by the National government in 1899, when the first annual report on the financial statistics of cities having a population of over 30,000 was issued by the Department of Labor, under authorization of an Act of Congress. Then in 1902, when the census bureau was placed on a permanent basis, the compilation of these statistics was transferred to that bureau, and reports on the financial statistics of cities of over 30,000 population have been published each year from 1902 to 1912. The number of cities covered by these reports has increased during the period from 146 to 195. It was expected, when the collection of municipal statistics was first undertaken by the National government, that the information could be gathered on schedules sent out to be filled in by the local officials. But on account of the unsystematic and divergent methods of municipal accounting and reporting in vogue throughout the country, this course was found to be impracticable, and it became necessary to send out field agents to secure the information on the ground.

It deserves to be noted that the method of tabulation and presentation employed in these reports conforms in general to a scheme devised by the Committee on Uniform Municipal Accounting and Statistics, of the National Municipal League, established in 1901, which did valuable pioneer work in this field. This committee made five annual reports in the period 1901–1905, and its members contributed twelve papers to the proceedings of the League. Dr. Edward M. Hartwell, secretary of the Boston Department of Statistics, was its chairman. Because of the chaotic condition of municipal statistics, the committee confined its work almost exclusively to matters relating to accounting and finance. The committee put forth a series of schedules which came to be known as the Uniform System of the National Municipal League. The characteristic feature of these schedules was the grouping of departmental receipts and disbursements under about a dozen general heads, for example; General, Government, Public Safety, Public Works, Public Debt, etc., according to the functions subserved

by the several departments of city government as they were then organized. The Committee was instrumental in stimulating discussion by accountants and fiscal officers of the principles of accounting and of measures calculated to promote reasonable uniformity in city bookkeeping. The National Municipal League's schedules constituted, in effect, a model comptroller's or auditor's report. In accordance with the schedules, the annual financial reports of various cities were restated in print, to show how the group system of uniform rubrics would work out in practice. Thus the League's schedules were utilized in fiscal reports of Newton, Mass., for 1900, Boston, 1900 and following years, Baltimore, 1901 and 1902; Chicago, 1902, Minneapolis, 1903, and Duluth, 1905.

2. In the field of investigation and supervision of municipal finances by state governments, two different plans of action have been tried. One is the compulsory method of Ohio, which in 1902 introduced a uniform system of municipal accounting, under the control of the state auditor, with the power to prescribe forms of fiscal reports for all cities. The other is the educational method of Massachusetts, as it may be termed. Instead of installing at once a uniform municipal accounting system throughout the Commonwealth, the Massachusetts legislature passed, in 1906, a law requiring auditors of cities and towns to furnish annually, on blanks prepared by the Bureau of Statistics, statements of revenues, expenditures, and indebtedness. The first report on Comparative Financial Statistics of Cities and Towns in Massachusetts for the year 1906 was issued by the Bureau of Statistics in 1908. The compilation of these statistics disclosed difficulties arising from the lack of uniformity or system in handling receipts and disbursements, and of proper methods of accounting on the part of the cities and towns. The result of the findings of the Bureau was the legislation of 1910, requiring notes to be issued in forms prescribed by the director of the Bureau of Statistics, and to be certified by him; also providing for the appointment of city and town accountants and for the installation of improved systems of accounting, with auditing by the director of the Bureau of Statistics,—upon the acceptance of these two provisions by the municipality. This pioneer work bore

gratifying results in the awakening of municipal authorities to the importance of adopting modern methods of financial administration.

In 1911 the Bureau of Statistics was ordered to investigate the indebtedness of cities and towns against which no sinking funds were in process of accumulation, or for the extinguishment of which no annual payments on the principal were being made. The Bureau made two investigations,—one a partial and preliminary inquiry, the other complete and exhaustive,—and reported its findings with recommendations. The investigations were supplemented by further inquiry through a legislative committee. The recommendations of the Bureau were finally embodied in the important legislation of 1913, which includes sixteen Acts relating to municipal finances. The most important of these is the Act relating to municipal indebtedness, which supplanted the old law of 1875. This Act was aimed at four evils: first, incurrence of funded or fixed debt for current expenses; second, temporary borrowings to an unlimited amount, in anticipation of tax collections; third, diversion of the principal of trust funds to current expenses for unauthorized objects, and incurrence of other liabilities without proper provision for payment; fourth, neglectful and costly management of sinking funds.

This legislation is a notable example of scientific law-making by application of the statistical method. The director of the Bureau, Mr. Charles F. Gettemy, who deserves great credit for the success of this experimental undertaking in state investigation and supervision of municipal finances, well says: "The true method of undertaking to accomplish a reform of long-standing evils should be, in my judgment, by a preliminary, scientific diagnosis of conditions, and I doubt whether any state can show an instance of legislation more thoroughly pre-digested, if I may use the term, than that which, without a dissenting voice in either branch of the legislature, has just been placed upon the statute books of Massachusetts for the purpose of restricting and regulating the incurrence of municipal indebtedness in accordance with sound financial principles."

3. In the establishment of statistical bureaus, as branches

of the city government, only a very small beginning has been made in this country. The field of municipal statistics proper remains in the United States a barren and neglected one. Boston led the way, as has been stated, establishing a department of statistics in 1897. The example of Boston in this respect was followed by New York, Baltimore, and Chicago, but the statistics departments in these cities were short-lived. Baltimore now has a municipal reference library, which performs some of the functions of a statistical department.

The Statistics Department of the city of Boston is in charge of a board of five trustees, appointed by the Mayor for a term of five years. The work is under the immediate direction of a secretary, Dr. Edward M. Hartwell, who has served the Board most efficiently from the beginning. The work consists in furnishing statistical information for use by the Mayor and heads of departments, answering inquiries of citizens of Boston and others parties, serving as a bureau for the exchange of documents with the principal cities of this country and Europe, and issuing regular and occasional statistical publications. The publications include: first, the Municipal Register, or hand-book of the city government; second, the monthly Bulletin, now published quarterly, containing tables grouped under twenty-two general heads, showing movement of population, work of city departments, statistics of the port of Boston, and other matters; third, a series of special publications relating chiefly to receipts and expenditures. In 1898–99 and for four months in 1900 a City Record was published weekly by the Statistics Department, but its issue was suspended through the refusal of the legislature to make the City Record self-supporting as the official gazette of the city government. Since the revival of the City Record, through the adoption of the new charter in 1910, the publication has been self-supporting, the editor being appointed by the Mayor. The Statistics Department has made many special studies, at the instance of the Mayor and Council, and heads of departments, which are too numerous to mention. Certainly the publications of this Department in the past fifteen years will bear comparison in point of variety, volume, and scientific method with those of any other city in this country.

4. The fourth line of statistical activity in the municipal field is represented by the well-known work of the New York Bureau of Municipal Research. Bureaus of municipal research have also been established in Philadelphia, Cincinnati, and Chicago. In Boston a Bureau of Municipal Research has been installed by the Finance Commission as an adjunct to its organization.

The New York Bureau was incorporated in May, 1907, its objects as stated in the charter being "to promote efficient and economical municipal government; to promote the adoption of scientific methods of accounting and reporting the details of municipal business, with a view to facilitating publicity in matters relating to municipal problems; to collect, to classify, analyze, to correlate, to interpret, and to publish facts as to to the administration of municipal government." The Bureau was placed under the direction of William H. Allen, Henry Bruére, and Frederick A. Cleveland. The methods of the Bureau are, in brief, to confer with officials responsible for the municipal department or conditions to be studied and secure their coöperation; to study the organization and distribution of powers and duties in the department; to examine the records of work done and the cost in the case of each official, each branch, or each class of employees; to coöperate with department heads in devising remedies through a change of system, without touching the personnel of the department directly; to present a formal report to the department head, the city executive officials, and the public, with description, criticism and suggestion; to follow up the first report in the press and through all agencies of publicity until results are secured.

Among the notable accomplishments to be credited to the Bureau may be mentioned: the removal of an incompetent Borough president by the Governor, upon evidence furnished by the Bureau; reorganization of the department of finance, with improved methods of inspection, audit, and payment; accounting reforms for all city departments; budget reform, exhibits, publicity; establishment of a Bureau of Child Hygiene in the Department of Public Health; changes for economy and efficiency in various departments; creation of the Herman

E. Metz National Fund for Promoting Efficient Municipal Accounting and Reporting in American Cities; establishment of a National Training School for public service, under the direction of the Bureau.

The New York Bureau has made a notable record for varied and strenuous activity. Its numerous reports and pamphlets make strong appeal to popular attention through skilful and forceful presentation of facts. It has done admirable service in the education of public opinion and the promotion of intelligent and vigilant citizenship.

In the light of this survey of accomplishment, let us next inquire in what ways the service rendered by statistics to the municipality can be extended and improved.

1. The municipal statistics collected and published by the National government through the Bureau of the Census are excellent, so far as they go, but they do not go far enough. The scope of this work should be extended to include social statistics of cities. Previous reports contain little more than statistics of receipts, expenditures, and indebtedness. Acknowledgment should be made of the fact that the reports for the years 1902, 1903, and 1907 contain some tables relating to other branches of municipal statistics besides financial statistics, for example: statistics relating to the organization and work of the police and fire departments; retail liquor saloons and licenses; water and sewerage works; resources and patronage of public libraries; length, area, construction, and care of streets; disposal of garbage; milk and dairy inspection; mortality statistics; and public school statistics. The last report for 1912, however, gives in addition to financial statistics, only figures of area, estimated population, and school attendance. The financial statistics, moreover, are less comprehensive than those contained in previous reports. General tables, such as those just mentioned, are conspicuous by their absence. It would seem that the Bureau of the Census ought to attempt, once in five years, to enlighten the public on other branches of municipal statistics besides those relating to financial administration.

It is greatly to be desired that the National government should issue a publication as comprehensive and detailed as

the Statistisches Jahrbuch Deutscher Städte. The nineteenth issue of this publication is edited by Professor Doctor M. Neefe, Director of the Statistical Office of Breslau, in collaboration with thirty-two experts occupying similar positions in other German cities. This issue of the Year Book embraces thirty-one special articles, covering 859 pages of text and comparative tables, mostly upon subjects quite beyond the ken of our municipal statisticians, for example; movement of population in 1910; building operations and dwellings; market in 1910; saving banks in 1910; the business of hotels and inns in 1907, 1910, and 1911; industrial tribunals in 1909 and 1910; passenger traffic in 1910, including omnibus, cab, and street-car traffic, as well as railroads and waterways; postal, telegraph, and telephone traffic in 1910 and 1911. Comparison of the nineteenth with the ninth issue of the Year Book shows an increase from 373 to 859 in the number of pages, from twenty-five to thirty-one in the number of special articles, and from nineteen to thirty-two in the number of Doctor Neefe's collaborators, who represented sixteen different German cities in 1901 and twenty-four in 1913.

2. A similar extension of scope is desirable in the case of the state publications of municipal statistics. Here, again, the reports contain only financial statistics. The need of extension to include social statistics is appreciated by the Director of the Massachusetts Bureau of Statistics. He is of the opinion, however, that this larger undertaking must be deferred until the work of collecting financial statistics shall have been put on a satisfactory basis. Concerning the further development of the statistical service rendered by the state to the municipality, he remarks: "In view of the laxity with which municipal accounts have hitherto been kept, we shall be accomplishing a good deal when we are able to show what our cities and towns are spending and the functions for which the expenditures are made; but it is, of course, of the utmost importance that we finally undertake to show what the people are getting for their money. When we have shown, for example, on as comparable and uniform a basis as possible, what our cities are spending for highways, we have done something; but mere statistics of expenditures, at best, tell only half the story, for

what a city ought to spend on highways is not reflected by the ledgers, however accurately and properly the accounts are kept. Some day, I hope, we shall be able to correlate with the expenditures for highways, statistics of mileage with a classification of costs based upon different kinds of pavements, etc., also to compare the expenditures for education with the number of pupils attending the schools, the aggregate amount spent for school teachers' salaries with the actual number of school teachers benefiting therefrom, and so on all down the line."

3. The first step in extending the statistical service rendered by the municipality to itself is obviously the establishment of a permanent non-political statistical bureau in every large city. On the continent of Europe, municipal statistical offices abound. The best organized and most efficient departments are found in those cities in which the problems of modern urban life have been met most successfully; for example, Berlin, Paris, Liepsic, and Vienna. In 1913, forty-six German cities having an aggregate population of 13,437,388 had statistical offices; those of Bremen and Berlin established in 1861 and 1862, respectively, are the oldest. Twenty-two of the whole number, or 48 per cent., have been established since 1900. In contrast with this extension of municipal statistical service in Europe, the field of such service has been neglected in the United States, because the majority of those who control the purse and administer the affairs of American cities are too short-sighted to devise appropriate methods or too supine and parsimonious to provide ways and means for cultivating the field.

The usefulness of a municipal statistical office can be increased in various directions beyond any results thus far achieved in an American city. One way to utilize such a department more effectively is to give it editorial supervision over the statistical work of other departments. There is great need of expert direction of the methods of recording and reporting statistics in the various departments of municipal government. The statistics of municipal administration need overhauling at the source. A vast amount of statistical rubbish is yearly dumped into print. The really valuable information is often presented in such crude fashion as to be mean-

ingless until worked over and shaped up properly. Dr. E. M. Hartwell makes the following pertinent comment on the existing methods of statistical presentation: "Municipal reports teem with tabular presentations of clotted facts. Too often they are ephemeral by-products of the administrative machinery. As raw material and a reminder of what is desirable, they often have some value, a value which is seldom proportionate to the cost in labor and money of separating the ore from the dross and refining the pig-metal till it becomes malleable and ductile." The duplication and confusion in department statistics could be eliminated by giving the statistical bureau authority to prescribe or recommend methods of statistical treatment.

Another opportunity of added usefulness for municipal statistics departments is through systematic coöperation with commercial, civic, and other organizations. The statistical service should be made widely valuable to the citizens at large. The possibilities in this direction are illustrated by a report prepared by the Boston Statistics Department for use in the recent movement to secure a regional bank for Boston. The report showed in a graphic way the large role played by Boston in the industrial, commercial, and financial activities of the nation, and the statistics made a most effective argument for the location of one of the regional banks in the city.

Finally, a municipal statistics department should assemble and publish in fairly compact and properly intelligible form the salient facts and figures concerning all the varied activities of the municipality. The municipal year-book should give a comprehensive picture of the life of the city in its essential phases. In this respect American municipal statistics fall far short of the state of the art as represented by the output of the average city statistical office on the continent of Europe. Indeed, no city in the United States publishes a year-book that will bear comparison as to diversity and comprehensiveness of contents and scientific presentation of data with the municipal year-book of the city of Tokio, Japan. The municipal year-book in an American city should be the source from which the citizen could get the facts about the food supply, the transportation system, the city markets,

street cleaning and paving, garbage collection and all other details of municipal housekeeping; the schools, parks, baths, playgrounds; the port, docks, terminals, freight movement; the banks, trusts companies, stock exchange; the churches, charities, hospitals, agencies of poor relief, and organizations for civic and social betterment; the hotels, theatres, clubs, and recreational institutions; the courts, jails, and reformatory agencies; the figures of births, deaths, sickness, accident, unemployment, and so on;—in short, all the multiform activities that make up the life of that extraordinarily interesting social organism, the American city. A year-book of this scope would be of invaluable assistance to officials, students, editors, publicists, social workers, and all persons interested in municipal affairs.

4. It is not possible to suggest any general program for the privately endowed and controlled bureaus of municipal research. This work must shape itself according to the concrete conditions and problems of the municipality in question. There is real need and place for such a bureau, to supplement the work of a regular statistics department in the city government. The latter as a coördinate branch of the municipal organization cannot investigate and criticize the other departments without imperiling its influence and even its existence. A bureau of municipal research supported by private contributions is not trammeled in this way. The rôle of such a bureau, however, is a peculiarly difficult one to play, for the way of the reformer or informer is often as hard as that of the transgressor. It is not easy for a research bureau to escape a reputation for chronic fault-finding and constant scolding. The temptation is to make too much noise at too frequent intervals. The directors of such work should bear in mind that constant barking dulls the public ear. The president of one of the most successful commercial organizations in this country recently said to me in commenting upon the proper policy in advertising: "Never yell unless you have something to yell about, and then yell like ——." This would make a good motto for a bureau of municipal research.

In general, finally, the chief need in the development of municipal statistical service in this country is extension and

coördination all along the line from the national to the local service. The various branches of this service, now independent and unrelated, must be brought into some sort of coherent connection. It is only when this service shall have been systematized and correlated thoroughly that statistics can render the full measure of possible usefulness to the municipality, for the general information of the citizens, the prevention of waste and corruption, the promotion of efficiency and economy, the scientific guidance of reform movements, and the effective advancement of the cause of municipal betterment.

THE PRESENT STATUS OF STATISTICAL WORK AND HOW IT NEEDS TO BE DEVELOPED IN THE SERVICE OF PRIVATE SOCIETIES AND ORGANIZATIONS.*

By W. S. Gifford, *Statistician, American Telephone and Telegraph Company.*

At this seventy-fifth anniversary of the founding of the American Statistical Association, I feel that perhaps it is bad taste, if not presumptuous, for one who has been a member only a comparatively short time, to call the Association to task for its present shortcomings and to offer suggestions as to what it ought to do in the future. However, not being in a position to talk with first-hand knowledge about the Association's past achievements, I may be forgiven if I speak out freely on a matter on which I have firm convictions and which I consider of vital importance to us all.

It is not my intention to define statistics or to state at just what point mere information or accounting ceases to be mere information or accounting and becomes statistics. That we must have knowledge or information to carry on any undertaking is obvious. That this information is today more and more frequently reaching such proportions as to be classed as statistics is perhaps not so obvious. I believe, however, that this lack of recognition is not due to any difficulty in proving that these accumulations of facts are properly statistics, but to ignorance of the present extent of such accumulations by private organizations.

Statistics, other than those compiled by governments, have been of comparatively recent development. Large private enterprises, somewhat resembling governments in their administration and organization, have developed rapidly in recent years in industrial, philanthropic, and academic fields. The very factors that have made them possible have also

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made possible private statistical work on a large scale. These private statistical undertakings heretofore would have been too expensive unless they could have been backed by the power of the government to enlist the aid of society as a whole, as has been the case in government statistical work. Now, however, statistics are both a possibility and a necessity. With the increased facilities for transportation and communication, resulting in the practical elimination of distances, large organizations supplant small organizations and increase the need for collective facts or statistics. Furthermore, the development of machinery and mechanical devices (such as tabulating and sorting machines) have aided private statistical work. In fact, private statistical work can now rival that of the government in many respects.

The incentive or motive for private organizations in such work is, it is true, usually selfish, while government motives are considered more altruistic. On the other hand, private undertakings are apt to be more logical and more suited to definite and practical needs. Statistics, even though compiled with a selfish motive, are entitled to consideration if they present the truth, and no private undertaking will intentionally expend time and money to compile data that will not present the truth; nor will it intentionally set up its facts in a manner that will be misleading to itself, whatever it may do in presenting such facts to others. In other words, a private society, if it is intelligently managed, is just as much interested in getting honest statistics as a government, and if those statistics are then presented with a view to mislead others, the society is dishonest and those responsible may justly be looked upon as liars.

We ought, therefore, to expect to find good statistical work in private fields today, and yet I know of nowhere to get much real information on this point. It seems a matter that has been sadly overlooked. I have tried to get a little light on the present extent of such statistical work with the feeling and hope that such knowledge will stimulate interest in statistics outside of government fields.

There are today hundreds of large business concerns, including almost every conceivable kind of public service corporation,

manufacturing and mining industry, wholesale and retail mercantile houses, and insurance companies, that are engaged in statistical work of more or less importance. True, much of the work is localized or special, but none the less of statistical value. In some cases, the men in charge of the work hold the title of statistician and are equipped with special training and experience, ranking as officers of the corporation with large well organized departments. In others, the work is in charge of men without special training who have been pressed into the service from the accounting or clerical ranks. We all know something of the statistical work done by railroads, as much of it is required by the Interstate Commerce Commission; but I doubt, for instance, whether we are aware of the vast amount of information as to internal movement of commodities in the country which can be obtained from data available in the offices of the railroads.

The statistical work done by some of the large electric light and power companies has been of high grade. A great deal of information gathered for use in developing and administering the business, such as classes of customers or amount of current consumed, provides statistics on the character of population of cities, etc., which should prove interesting to the statistician.

Extensive development studies of telephone companies in various cities provide valuable data as to the probable future growth and spread of the population in the cities. This data is compiled in elaborate detail in order that plant may be properly laid out to take care of the population twenty years hence. It is obtained by a complete house-to-house study of the entire city.

Records of employees of large corporations, although a field which has not yet been developed to any marked degree, present another source of valuable statistical information. There are today two hundred or three hundred large corporations which have some sort of accident disability, sickness disability, pension or death benefit plan. These corporations probably employ considerably over a million wage earners and these wage earners, with their families, would constitute quite a respectable portion of our total population. Ultimately,

in connection with these welfare plans, information that has never been secured before by government inquiry will be obtained about employees.

The statistical work done by some large firms, to determine the results of their different kinds of advertising or the results of the same advertising in different parts of the country, might throw some light on the psychology of society.

In addition to these business enterprises, and closely allied with them, is the statistical work of such trade associations as the Chamber of Commerce of the United States whose purpose, among other things, is to furnish members with up-to-date information obtained as the result of extensive research and compilation of statistics of various sorts.

The Copper Producers' Association publishes regularly a report upon the stocks of copper on hand and the production and consumption of copper.

Again, there are such enterprises as Babson's or Brookmire's which compile and publish statistics on business and financial conditions. Statistical bureaus, such as the Bureau of Railway Economics, are maintained by associations of railroads or other enterprises. There are Trades Unions, the National Bankers' Association, the National Consumers' League, the National Civic Federation, and numerable other agencies busy with statistical compilations. So much for a hurried survey of the present statistical work in business and its allied fields.

In addition, we have large social enterprises, such as the Russell Sage Foundation, the National Education Board and the Carnegie Foundation, which are undertaking elaborate statistical surveys, and there are investigating commissions of various sorts, some organized by the government and some by private initiative, but all of which collect statistical data.

I have not even mentioned the statistical work of the biologist, the eugenist, the doctor, etc. We even have elaborate statistical compilations in the field of sports, such as baseball and football.

I have not tried to do more than give a rough sketch of the present ramifications of statistical work in private organizations and societies. We only need to look at a daily newspaper to realize that people are today more and more relying

on statistics and facts to prove their points. To tell the truth, it would seem at times as if we were attempting to prove too much rather than too little by statistics, particularly as our statistics are by no means always scientifically correct. So far as the public is concerned, government statistics by no means monopolize the field.

As to the future of this tremendous private work, which is at present in somewhat of a chaotic state, I would like to make a few suggestive statements.

The work is still in its infancy and will, of necessity, grow rapidly in the near future. What restrictions or rules are there to prevent it becoming more chaotic, more inaccurate and misleading? No laws protect the public from being misled by false and inaccurate statistics. Rather than let the work develop in chaos along these unscientific lines, why should not the American Statistical Association make determined efforts to interest such people as are engaged in this private statistical work? Why should it not build up an association of *all* statisticians? By developing a certain professional code as well as practical rules and regulations, inaccurate statistics can be branded as untrue and their sponsors can be severely censured. Statistics will not, it is true, in themselves, solve all the problems in the world—in these problems the whole is always greater than the sum of the parts, but statistics have an increasingly important place today in the future development, both of the people of this country and all the countries in the world.

Why not recognize the statistical work of private organizations and societies and place it, so far as professional standing is concerned, alongside of government work and out of both obtain a larger truth.

The idea that the statistics of private enterprises are "trade secrets" is fast becoming obsolete, partly through necessity caused by government regulations and enforced publicity, and partly through the adoption of broader and more generous ideas.

The American Statistical Association, after seventy-five years of honored and respected existence, now faces the fact that it recognizes probably not much more than half of the

statistical work being done in this country. I feel very strongly that if, twenty-five years hence, it wishes to look back with pride to its accomplishments, it must take immediate steps to become an aid and source of inspiration for *all* interested in arriving at truth through statistical data, whether they are engaged in work under the government, in academic circles, or in private societies and organizations.

A NATIONAL BUDGET.*

By Harvey S. Chase, S.B., C.P.A.

It must be remembered in discussions concerning the national budget that there are, necessarily, two viewpoints which are quite distinct. One of these is the *inside* viewpoint and the other is the *outside.* One is the viewpoint of Congress and of the executive departments; the other is that of the intelligent citizen and of the economist interested in governmental finance.

Both viewpoints must be provided for in a complete national budget. The first requires that the "estimates" (proposed expenditures) shall be classified according to *units of organization, i. e.,* the departments, divisions, and establishments which are to spend the appropriations. The second requires that the estimates be classified according to *purposes* of expenditure (*functions* of government), irrespective of the title of the department or division which is to spend the money.

The great difficulty heretofore in budget consideration has been the attempt to condense these two viewpoints into one, and to set up only a single classification. With such a classification, if arranged by organization units, the outsider (citizen, or economist), can get little information concerning expenditure for *purposes.* If, on the other hand, the classification is made according to purposes and functions, than the average congressman is likely to claim that he can not make head or tail out of it so far as appropriations and legislative requirements are concerned.

This situation being acknowledged and the reasons for it perceived, it becomes evident that the budget compiler should provide *both* classifications, that is to say, the same total figures should be arranged in two detailed systems, one for the insider and the other for the outsider. Such double classifications are provided herein.

*Based upon the Estimates for the new Fiscal Year (1915) beginning July 1, 1914, which were submitted to Congress by the Secretary of the Treasury, December 1, 1913.

As the present statement is intended to illustrate the needs of the outside intelligent citizen rather than that of the inside official of the government, I have placed the functional analysis first and the organization analysis second.

The Relationship between "Revenue" and Expenditure."

All government expenditure must ultimately be met by revenue and by revenue only. The issuance of bonds or other evidences of debt is merely a temporary expedient—in sound financing—and the payment of these debts must come from *revenue, i. e.*, from surplus revenue devoted specifically to this purpose.

All nations with responsible ministries provide revenues for their respective governments by means of budgets. The finance minister prepares estimates of the needed expenditure in summary and in detail. He submits these estimates to the legislative body or bodies, together with estimates of revenue, also in summary and in detail. He balances these, one against the other, increasing taxes in number or in rate, if more revenue must be had; or cuts expenditure estimates if taxes cannot safely be increased—whether for political or economic reasons.

The central feature of the budget is this balance of revenue against expenditure. It is the primary necessity in nearly all national finance. It is the danger signal and the rallying point for the opposition to a party or a ministry.

In the United States, we have not had this fundamental requirement of national finance for many years, mainly because of the phenomenal growth of our wealth and our population, and because our taxes have been principally *indirect* taxes—custom duties, established for purposes of "protection." Revenue has not been dependent, therefore, upon expenditure, with corresponding direct taxation as in most other nations. On the contrary, revenue has been produced incidentally, as it were, and usually in excess of the amount needed for economical and efficient administration. Hence our extravagance as a nation; hence our public building bills; our rivers

and harbors' acts; our inefficient civil service, our "pork barrels," and our contempt for economies and economics.

This indirect revenue is one of the reasons why this country has never had a budget and yet has gone on from year to year growing ever more wealthy, ever more extravagant, and ever more contemptuous of budgetary requirements and of the financial methods of foreign nations. Now, in 1914, we are beginning to be pulled up with a round turn. Now, with our tariff reforms and our income taxes, we are departing sharply from the ways of the fathers. Moreover, in our private business competitions, we hear and join in the slogan of "efficiency," which tends to dominate the activities of business of the present day. It is creeping into governmental methods likewise; into our cities and our states,—witness "commission government" in cities, and note "university extension" in state affairs; into our national departments—witness the demand for cost accounting and for uniform classifications of expenditures. What do these developments mean? What do they portend? Evidently an approach to a closer balance between revenue and expenditure, to an increased attention to this relationship, and to a sharper critical demand for efficiency—which necessarily includes economy—in government expenditure. In other words, it portends the approach of the budget and budgetary methods in national finance in this country, as in other countries.

The First Step.

The first step must necessarily be the broadest step, if not the highest. This step is outlined in the exhibits and explanations which follow. This step is practicable, and should be taken promptly. To illustrate it, suppose that the President is about to submit to Congress and to the public his annual message at the beginning of the session. He has, we will say, adopted the budget idea and has prepared a message supported by tables of figures based upon estimates of proposed expenditures and estimates of expected revenues furnished to him by his cabinet officers and the heads of the government establishments. These estimates have been prepared in two ways. First, in the ordinary way, as required by present legislation.

Secondly, in a new way, arranged in logical order and intelligible sequence, grouped by purposes or functions of government, and segregated by character of expenditure, whether for current expenses or for capital outlays and for subdivisions of each. The revenues, too, have been carefully calculated and compared with other years, due allowances have been made, non-revenue receipts eliminated, trust funds and trust income separated, all remaining revenue concisely classified, and the available total determined. The President, with the advice of his Cabinet—and probably with the assistance of a "central administrative accounting bureau"—has prepared these estimates of revenue and of expenditure in budgetary form. He has struck a balance. He has accepted the anticipated result, whether it be a surplus of revenue or a deficit. If the latter, he has considered methods of providing for the deficit. With these data before him, he constructs a budget as follows: He sets up the revenues by classes with explanations and a final total. He tabulates the proposed expenditures, classified as exhibited below. He first deducts from the total estimated revenue, the "fixed charges" which must be met without question—such as interest on public debt, definite debt redemptions, revenues required for trust fund liabilities, or other special funds, pension requirements, recurrent allowances for upkeep and maintenance of public buildings, grounds, parks, and the public domain generally. Having totalled these and deducted the total from the expected revenue, he next exhibits the necessary, perhaps unavoidable, expenditures for military and naval purposes, for continuation of engineering projects of great importance, and for similar requirements. The total of these is again subtracted from the remaining revenue and an amount of revenue is left which is available for less mandatory purposes. Concerning the expenditure of this portion of the revenue there may be considerable question and discussion.

Whether, for instance, more shall be spent for stimulation of agriculture, with less for promotion of commerce; whether less should be provided for the function of education and more for public health, or vice versa; whether or not labor and the laboring classes need additional promotion, or whether defect-

ives and dependents should be more liberally provided for. The wards of the nation, Indians and others, would be discussed and their necessities considered; our foreign relations, embassies and commercial attaches would have due attention; all the various functions and activities would have each its needful consideration from the general standpoint of its relative importance to all other expenditure and to the available revenue.

Such an analysis of the finances of the government, of the purposes and character of expenditure, and of the relations of the latter to the expected revenue would present a picture of supreme interest to every intelligent citizen in the country and one of the greatest importance in the efficient handling of financial problems by Congress.

It goes without saying that such an exhibit by the President at the opening of Congress would be intensely stimulating to the public, would awaken nation-wide interest, would provoke discussion and criticism, would flood the mail boxes of Congressmen with urgent appeals to increase here and to cut down there, and would open the eyes of the members themselves as to what could be done and what could not be done in the way of modification and change without upsetting the balanced relations of revenue and expenditure *in toto.*

Recomendations by Former President Taft.

President Taft sent a budget message to Congress in February, 1913. In this message he said: "Under the Constitution, the power to control the purse is given to Congress. But the same paragraph also requires of the administration the submission of a regular statement and account of the receipts and expenditures." "The President shall, from time to time, give to the Congress information of the state of the Union and recommend to its consideration such measures as he shall judge necessary and expedient. Pursuant to these constitutional requirements, I am submitting estimates of revenues and expenditures in the form of a budget."

President Taft recommended in this message that appropriations should be enacted hereafter under four general classifications and that accounting for "expenditure" by the

departments and establishments should follow the same classifications, namely:

1. Appropriations for "operation," including administration.

2. Appropriations for "upkeep of property" (repairs, maintenance, and depreciation).

3. Appropriations for "fixed charges," including interest and redemption of the public debt.

4. Appropriations for "permanent improvements" (land, buildings, equipment, new construction, etc.).

In relation to these he advised that the first class should be provided by annual appropriations, ordinarily, though in many cases by biennial, triennial, or other less frequent appropriations; the second should be provided by "replacement funds," through permanent appropriations; the third by permanent appropriations, "recurrent," without further legislation; the fourth by permanent appropriations from which allotments may be made annually. Such allotments should be definitely provided from revenue or from bond issues, as may be specified. If the latter, the bonds should be retired on short terms by effective sinking-fund provisions, or by serial redemptions.

The New and Improved Tables.

The primary distinctions exhibited in Table I are five: (1) War purposes, (2) Civil purposes (other than postal), (3) Postal purposes, (4) General administrative purposes, (5) Local government purposes. The secondary distinction in each of these primary divisions is the separation into "operation and maintenance expenses," contrasted with "construction and improvement outlays." These are the titles of the first two columns in the following detailed exhibit, while the third column represents the totals of the first two columns. These columns set forth important information which has not been available heretofore in government estimates or publications. This separation is fundamentally necessary if comparisons with previous or subsequent years are to be made, or correct ideas obtained concerning extravagance or economy in the expenditure of public money.

TABLE I.

EXPENDITURES FOR THE FISCAL YEAR 1914-15—"ESTIMATES" OF APPROPRIATIONS, CLASSIFIED BY PURPOSES OR FUNCTIONS.

	Operation and Maintenance Expenses.	Construction and Improvement Outlays.	Total Estimated Expenditures.
FOR WAR PURPOSES—Army, Navy, War Pensions, War Debts.			
Current Charges. Annual Appropriations.[1]			
Defense by land (Military)	$100,249,712	$14,379,198	$114,628,910
Defense by sea (Naval)	98,311,306	42,490,734	140,802,040
Administration: Secretary of War	148,040	....	148,040
Adjutant-General's Office	730,570	....	730,570
Quartermaster Corps	378,670	....	378,670
Engineers and Insular affairs	208,581	....	208,581
Other offices, War Department	456,598	....	456,598
Administration: Secretary of the Navy	76,460	....	76,460
Bureaus: Navigation, Intelligence, Records	108,790	....	108,790
Bureaus: Engineering, Repairs, Yards and Docks	106,430	....	106,430
Bureaus: Supplies, Accounts and other offices	304,660	....	304,660
Operation and maintenance (‡) of the State, War and Navy Building[1]	188,013	2,000	190,013
War pensions, retirements, veterans' homes, etc.	186,674,527	23,424	186,697,951
	$387,942,357	$56,895,356	$444,837,713
Fixed Charges. Permanent Appropriations.[7]			
Interest on war debts	13,000,000	....	13,000,000
Sinking-fund provisions for war debts[4]	37,000,000	....	37,000,000
Trust funds, established by war requirem'ts	2,770,000	....	2,770,000
Special funds and accts. for war purposes	5,574,477	....	5,574,477
Total for War Purposes	$446,286,834	$56,895,356	$503,182,190
FOR CIVIL PURPOSES—State, Interior, Agriculture, Commerce, Labor, Etc.			
Current Charges. Annual Appropriations.[7]			
Commerce, Banking, Etc.			
Promotion and regulation of commerce	$3,578,305	....	$3,578,305
Promotion of transportation:[5]			
Improvements of rivers and harbors	3,197,815	$38,286,080	41,483,895
Lighthouses, life saving, roads, surveys, engineering, etc.	12,484,004	2,679,700	15,163,704
Panama Canal	1,546,395	22,228,760	23,775,155
Regulation of currency, coinage, etc.	5,862,452	....	5,862,452
Regulation of banking	194,240	....	194,240
Natural Resources, Agriculture, Etc.			
Promotion of agriculture[5]	8,951,617	47,500	8,999,117
Promotion of forestry	5,390,741	477,590	5,868,331
Care and utilization of public lands	3,184,920	10,000	3,194,920
Promotion and regulation of mining, water power, etc.	2,284,520	....	2,284,520
Meteorological research, weather bureau, etc.	1,667,270	3,000	1,670,270
Promotion of fisheries	1,155,730	255,900	1,411,630
Welfare, Labor, Etc.			
Promotion of the welfare of the laboring classes and regulation of labor[6]	4,068,250	812,200	4,880,250
Promotion of public health[6]	4,087,062	104,700	4,191,762
Promotion of education and recreation[6]	1,349,376	1,271,014	2,620,390
Provision for Indians and wards of the nation[6]	9,295,715	1,635,400	10,931,115
Provision for defectives, dependents, etc.	1,565,349	455,000	2,020,349
Patents, Standards, Statistics, Etc.			
Patents and copyrights	1,626,300	....	1,626,300
Statistical research, census, etc.	1,709,720	....	1,709,720
Standards of measurements, etc.	837,175	395,000	1,232,175
Foreign Affairs and Dep't. Administration:			
Foreign affairs and relations[6]	3,920,970	477,000	4,397,970

TABLE I—(*Continued*).

	Operation and Maintenance Expenses.	Construction and Improvement Outlays.	Estimated Expenditures.
Administration; Dep't of State	354,060	....	354,060
" " " Interior	634,040	....	634,040
" " " Agriculture	765,968	....	765,968
" " " Commerce	252,160	....	252,160
" " " Labor	183,040	....	183,040
Operation and maintenance, (½) State, War and Navy Building [1]	94,007	1,000	95,007
	$80,241,221	$69,139,844	$149,381,065
Fixed Charges. Permanent Appropriations.[7]			
Interest on bonds other than for war purposes	$9,900,000	....	$9,900,000
Sinking-fund provisions for other than war purposes [4]	23,717,000	....	23,717 000
Trust funds provisions for other than war purposes	7,772,730	....	7,772,730
Special funds and accounts for other than war purposes:—Viz.:			
Promotion of transportation facilities:			
Operating canals	$2,000,000	....	$2,000,000
Protection of navigable streams	2,000,000	....	2,000,000
River and harbor improvements	....	$679,600	679,600
Roads and trails	....	420,000	420,000
Promotion of Agriculture:			
Reclamation fund	....	9,000,000	9,000,000
Colleges of agriculture and mechanic arts	2,500,000	....	2,500,000
Experiment stations, etc.	48,200	....	48,200
Promotion of public health:			
Meat inspection, Bureau of Animal Industry	3,000,000	....	3,000,000
Promotion of education, recreation, etc.:			
National forest fund	600,000	....	600,000
2, 3, and 5 per cent. funds to States	225,000	....	225,000
Maintenance national parks, etc.	125,000	....	125,000
Public schools, territories	100,000	....	100,000
Education of blind, etc.	11,000	....	11,000
Care of Indians:			
Civilization of the Sioux	800,000	....	800,000
Medium of exchange:			
National currency, contingent expenses, etc.	280,000	....	280,000
Foreign affairs:			
Pay of consular officers in transit	65,000	....	65,000
Care of defectives:			
Indigent. Alaska	25,000	....	25,000
Totals of special funds and accounts	$11,779,200	$10,099,600	$21,878,800
Other permanent appropriations for other than war purposes	$381,500	....	$381,500
Totals for Civil Purposes (except Postal)	$133,791,651	$79,239,444	$213,031,095
FOR POSTAL SERVICE.			
Postal service, payable from postal revenues	$306,953,117	....	$306,953,117
Administration of Postmaster-General's Dep't	1,850,000	....	1,850,000
Operation and maintenance of post offices, etc.[1]	....	....	....
Totals for Postal Service [1]	$308,803,117	....	$308,803,117

TABLE I—(*Concluded*).

	Operation and Maintenance Expenses.	Construction and Improvement Outlays.	Estimated Expenditures.
FOR GENERAL ADMINISTRATIVE PURPOSES—Legislative, Executive, Judicial, Etc.			
Covering requirements both for war and for civil purposes.			
Current Charges. Annual Appropriations.[7]			
Legislative:			
The United States Senate	$1,849,287	$8,500	$1,857,787
The House of Representatives	4,956,985	....	4,956,985
Judicial:			
The Supreme Court and other courts	6,299,110	....	6,299,110
Executive:			
The President, Vice President and the executive offices	210,440	....	210,440
Civil Service Commission	450,165	5,000	455,165
Collection of the revenues, etc.—Treasury	17,247,650	125,000	17,372,650
General accounting and auditing—Treasury	1,752,080	....	1,752,080
Operation and maintenance of public buildings and grounds[1]	8,098,412	....	8,098,412
Construction and improvement of buildings and grounds	....	6,302,584	6,302,584
Public printing, all departments	5,892,408	130,000	6,022,408
Genreal Supply Committee[2]	65,640	....	65,640
Reference and library purposes	465,585	127,000	592,585
Distribution of documents	318,275	....	318,275
Administration of Treasury Dep't	1,890,770	....	1,890,770
Administration of Dep't of Justice	777,711	....	777,711
Detection of crimes, legal advice, etc. (Justice)	2,694,620	....	2,694,620
Total	$52,969,138	$6,698,084	$59,667,222
Fixed Charges. Permanent Appropriations.[7]			
Revenue refunds, drawbacks, etc.	$8,470,000	....	$8,470,000
Retired judges, Hawaiian judges, etc.	175,500	....	175,500
Revenue Collection, night services	225,000	....	225,000
Totals for General Administration Purposes	$61,839,638	$6,698,084	$68,537,722
FOR LOCAL GOVERNMENT PURPOSES.			
Territorial Governments	$304,638	....	$304,638
Philippine customs and internal revenue	321,000	....	321,000
District of Columbia	10,911,094	$3,580,521	[3] 14,491,615
Militia, industrial schools, etc.	10,400	....	10,400
Totals for Local Government Purposes	$11,547,132	$3,580,521	$15,127,653
Grand Totals, All Purposes	$962,268,372	$146,413,405	$1,108,681,777

[1] Operation and maintenance expenses of office building, rents, etc., are mainly included in item [1] in "General Administrative Purposes," because these expenses can not be separated, under present methods of bookkeeping.
[2] This amount should be distributed in detail to the various departments and divisions.
[3] Approximately one-half of this is offset by District of Columbia revenues.
[4] Sinking-fund provisions are negligible; merely bookkeeping items having no actual existence. There are no securities and no cash in the, socalled, "sinking fund."
[5] See also additional estimates under "permanent appropriations."
[6] Including Bureau of Naturalization, $250,000.
[7] These terms "annual" and "permanent" might be better stated "current" and "recurrent," as all appropriations are enacted annually by Congress, even though the amount is not fixed, (indefinite) or the time is not fixed (indeterminate).

CLASSIFICATIONS BY (a) APPROPRIATION A

Units of Organization. Departments, divisions, etc.	Permanent Annual Acts.	Legislative, Executive, and Judicial Act.	Sundry Civil Act.	Diplomatic and Consular Act.	Army Act.	Fortifications Act.	Military Academy Act.
Legislative:							
U. S. Senate		$1,857,788					
House of Representatives		4,956,985					
Library of Congress	$800.00	695,165					
Botanic Gardens		23,394	$7,000				
Executive:							
President and Vice-President		185,440	25,000				
Civil Service Commission		414,540					
Department of State	171,000	354,060		$4,447,043			
Treasury Department	92,943,000	12,597,497	36,903,550				
Government in Territories	53,000	207,138					
State, War and Navy Building		285,020					
War Department	9,317,600	1,944,718	43,561,888		$104,947,759	$9,124,399	$1,0[illegible]
Navy Department	1,881,477	862,390					
Department of the Interior	19,767,500	5,761,765	6,285,208				
Post Office Department		1,850,000					
Department of Agriculture	5,999,200						
Department of Commerce	3,000	5,043,810	8,636,960				
Department of Labor		790,010	3,973,480				
Department of Justice		612,880	1,483,332				
Lincoln Memorial Commission			600,000				
Public Printer			6,340,683				
Commission of Fine Arts			7,500				
Judicial	147,500	1,242,110	7,402,856				
Independent Offices:							
Smithsonian Institution	57,630		821,850				
Interstate Commerce Commission			1,695,000				
Board of Mediation and Conciliation							
Commission on Industrial Relations							
District of Columbia	854,700						
	$131,196,407	$39,684,710	$117,744,307	$4,447,043	$104,947,759	$9,124,399	$1,0[illegible]

...ED BY (b) UNITS OF ORGANIZATION.

General ...	Rivers and Harbors Act.	Pension Act.	Indian Act.	Agricultural Act.	Postal Act.	District of Columbia Act.	Public Bills.	T...
								$
								14
	$34,296,395							20
...17,453								14
		$169,150,000	$10,208,865					21
					$306,953,117			30
				$19,061,332				2
							$1,635,500	1
							50,000	
							250,000	
						$14,491,614		1
...17,453	$34,296,395	$169,150,000	$10,208,865	$19,061,332	$306,953,117	$14,491,614	$1,935,500	$1,10...

Table II exhibits a summary from the insider's viewpoint. The details of this viewpoint fill eight hundred and seventy quarto pages in the "Book of Estimates, 1915," and will fill nearly as many more in the "Digest of Appropriations, 1915." This summary has been arranged in columnar form, each column exhibiting the title of an Appropriation Act by Congress. (It should be remembered that all of these figures are "estimates," not final appropriations.) The primary divisions of the government, "legislative," "executive," and "judicial," as well as the subdivisions—departments, establishments, etc.—are set forth in the title column at the left. Our analysis consists in the distribution of items pertaining to each unit of organization to the proper column representing an appropriation act. By this classification, the wide distribution of such items is clearly exhibited and the advantage of some better method of grouping appropriations becomes evident.

TABLE III.

For comparison with the two methods exhibited of expenditure estimates, we provide a classification for revenues, which is self-explanatory in the main. The primary division is into *Special* revenues and *General* revenues. The first is applicable only to special purposes under requirements of law, or to revenues which arise on account of various classes of expenditure. The second consists of revenues which are unrestricted either by requirements of law or of accounting and which are available for the general expenditures of the government under current appropriation acts. The following table sets forth the actual revenues for the last fiscal year (1913) as an illustration of a proper classification of the revenues, by estimates, for the new fiscal year (1915), or for some subsequent year:

TABLE III.

REVENUES (ACTUAL) FOR THE FISCAL YEAR, 1912-13 (AS A BASIS FOR ESTIMATES OF REVENUE FOR 1914-15).

I. SPECIAL REVENUES:

Viz: (a) Revenue reserved by law for special purposes, and also (b) revenues arising on account of special classes of expenditure although not specifically reserved for such purposes by law.

(a)			
Revenue of trust funds		$12,085,561	
District of Columbia revenues		8,070,369	
Reclamation fund (sales, fees, etc.)		3,585,271 (1)	
Contributed moneys (rivers, harbors, etc.)		1,039,308	
Navy fines, forfeitures, small stores, etc.		985,824	
National forests fund		749,996	
Philippine fund		308,986	
Sales public lands, 2, 3, and 5% funds (States)		238,890	
Night service—customs		229,971	
Alaska fund		205,097	
Sales of ordnance material		202,432	
National forests and Hot Springs Reservation		95,250	
Sales of timber, sites, products, etc.		16,788	
Forest service co-operative fund		6,748	
		$27,821,301	
Increments to appropriations:			
Panama Canal	$2,377,029		
"	1,693,148		
		4,070,177	
Gain on exchange (Navy)		18,766	
Interest on daily balances (Navy)		6,290	
Total "a"			$31,916,534
(b)			
Immigration fund (head tax)		$4,735,062	
Patent fees		2,077,102	
Counsular and consular court fees		1,796,408	
Forest service		1,716,931	
Customs fees, fines, penalties, etc.		1,590,355	
Judicial fees, fines, penalties, etc.		1,123,950	
Fees, etc., Land offices		547,000	
Reimbursement for advances to Indian funds		531,916	
Reimbursement for expenses Nat'l Bank Redemption Agency		505,735	
Recoveries of bullion and expenses on coinage		440,810	
Naturalization fees		390,425	
District of Columbia, fees, rents, etc.		290,031	
Navigation fees, fines, penalties, etc.		191,695	
Earnings on telegraph and telephone lines		186,749	
Sale of seal and fox skins, Pribilof Islands		151,146	
Recoveries, river and harbor frauds		127,973	
Copyright fees		117,100	
Depredations on the public lands		103,600	
Reimbursements for work and costs, various departments		84,968	
Immigration fines, fees, and penalties		72,905	
Purchase of discharges, Navy and Marine Corps		66,304	
Net profits on ships' stores		40,294	
Passport fees		28,384	
Copying fees—General Land Office		21,162	
Maintenance charges, etc., Irrigation systems		14,394	
Testing fees, Bureau of Standards		14,251	
Earnings on transports		9,755	
Forfeitures by contracts		8,050	
Miscellaneous fees		6,368	
Miscellaneous refunds and rebates		6,254	
Game licenses—Alaska		4,845	
Chinese exclusion, fines, fees, etc.		2,654	
Testing fees—Bureau of Mines		2,005	
Revenue Crater Lake and Mesa Verde Parks		1,399	
Revenue Nat'l Training School for Boys		813	
Internal revenue, fines, fees, etc.		200	
Total "b"			$17,010,993
Total Special Revenues "a" and "b"			$48,927,527

II. General Revenues:

Viz.: Revenues available for any purposes of the Government which arise from sources not specialized either by law or by corresponding expenditure.

Customs		$318,891,396	
Less, duties on imports from Philippines (Special)		1,184	
			$318,890,212
Internal revenue:			
Ordinary		309,410,666	
Less, Philippine revenue (Special)		307,802	
			309,102,864
Corporation tax			35,006,300
Public lands receipts		$2,910,205	
Less, pledged to special purposes, viz.: Reclamation fund[1]	$2,492,607	2,731,497	
2, 3, and 5% funds	238,890		
			178,708
Seigniorage, silver and minor coinage			5,104,338
Tax on circulation of National Banks			3,730,059
Sales of Government property			1,325,167
Compromise and repurchase of forfeited lands			648,583
Chinese indemnity			644,500
Rental of public property			268,301
Unclaimed moneys (Treasury)			47,490
Interest on public deposits			34,610
Recoveries of damaged and lost property			16,987
Interest from Pacific railways			9,493
Conscience fund, etc.			3,136
Gain on exchange (State Dept. and Treasury)			1,206
Assessments on owners for deaths on shipboard			1,040
Interest on debts due U. S. (various debts)			946
Recovery, principal and interest Louisiana bonds			326
Miscellaneous			1,056
			$675,015,322

Summary.

Special Revenues "a" (By law)	$31,916,534	
Special Revenues "b" (By expenditure)	17,010,993	
Total		$48,927,527
General Revenues		675,015,322
Grand Total		$723,942,849

Reconciliation.

Grand total as above	$723,942,849	
Add: receipts of 1913 not covered into Treasury by warrants in 1912–13	505,971	
	$724,448,820	
Deduct: receipts of previous years covered into Treasury by warrants in 1912–13	337,590	
Net grand total revenues (excluding postal revenues, which were $266,619,526)	$724,111,230	per Secretary of the Treasury's Annual Report.

[1] In addition to this sum there are other receipts into the Reclamation Fund for repayments of water-rights charges, and other sources, amounting to $2,383,126.

Table IV exhibits the form in which the President of the United States might present to the Congress, at the opening of a session in December, a financial plan for the ensuing fiscal year. Each item would be supported by a detailed schedule:—

TABLE IV.

SUMMARY OF THE NATIONAL BUDGET.

	Estimates for the Fiscal Year, 1915.
SOURCES OF REVENUES.	
Total estimated Revenues, (other than postal revenues)	$728,000,000
Deduct revenues for special purposes, (Schedule I)	50,000,000
Remainder, Revenues available for general purposes, (Schedule II)	$678,000,000
PURPOSES OF EXPENDITURE.	
Fixed Charges. (Schedule III.)	
Viz.: For interest on public debts[1]	$22,900,000
For sinking-fund[2]	60,717,000
For trust funds[3]	10,542,730
For special funds[4]	27,453,277
For refunds, retirements, etc.[5]	9,252,000
Totals	$130,865,007
Eliminate sinking-funds[2]	60,717,000
Remainder of fixed charges	$70,148,007
Deduct, portion to be provided from special revenues	50,000,000
Remainder, required from general revenues	$20,148,007
Summaries.	
General revenues, as above	$678,000,000
Remainder of fixed charges, as above	20,148,007
Revenue available for current appropriations	$657,851,993

ESTIMATES OF CURRENT APPROPRIATIONS.

WAR PURPOSES. (Schedule IV.)	
(a) *Operation and Maintenance:*	
Viz.: Defense by land, (Military)	$100,249,712
Defense by sea, (Naval)	98,311,306
Administration: Secretary of War	148,040
Other offices, War Department	1,774,419
Administration: Secretary of the Navy	76,460
Bureaus and other offices, Navy Department	519,880
Operation and maintenance (⅔) State, War and Navy Building	188,013
	$201,267,830
War pensions, retirements, veterans' homes, etc.	186,674,527
Total	$387,942,357
(b) *Construction and Improvement:*	
Viz.: Fortifications, etc. (Military)	14,379,198
Battleships, etc. (Naval)	42,490,734
Veterans' homes, etc.	25,424
Total War, except "fixed charges"	$444,837,713

Civil Purposes. (Schedule V.)	
(a) *Operation and Maintenance:*	
Viz.: Commerce, Banking, etc.	$26,868,211
National Resources, Agriculture, etc.	22,694,796
Welfare, Labor, etc.	20,366,752
Standards, Statistics, etc.	2,546,896
Patents and copyrights	1,626,300
Foreign Affairs	3,920,970
General Administration:	
Department of State	354,060
" " Interior	634,040
" " Agriculture	765,988
" " Commerce	252,160
" " Labor	183,040
Operation and maintenance of public buildings and offices[6]	94,007
Total	$80,241,221
(b) *Construction and Improvement:*	
Improvement of rivers and harbors	$38,286,080
Panama Canal	22,228,760
Lighthouses, etc.	2,679,700
Other (see detailed schedules)	5,945,304
Total Civil, except fixed charges	$149,381,065
Postal Purposes.[7]	
Postmaster-General's department	$1,850,000
General Administrative Purposes. (Schedule VI.)	
(a) *Operation and Maintenance:*	
Viz.: Legislative	$6,806,272
Executive, (except above in Civil)	39,863,756
Judicial	6,299,110
Total	$52,969,138
(b) *Construction and Improvement:*	
Public buildings and grounds	6,302,584
Other	395,500
Total general administrative except fixed charges	$59,667,222
Local Government Purposes. (Schedule VII.)	
(a) *Operation and Maintenance:*	
District of Columbia	$10,921,494
Territorial governments, customs, etc.	625,638
Total	$11,547,132
(b) *Construction and Improvement:*	
District of Columbia	3,580,521
Total local government purposes	$15,127,653
Grand Total All Purposes.	
(Excluding fixed charges, postal service, and sinking fund)	$670,863,653

Recapitulation, 1915.

Revenue available for current appropriations	$657,851,993
Estimates of current appropriations	670,863,653
Deficit of estimated revenue (1915)	13,011,660
Panama Canal estimates, if bonds are issued, may be deducted from total current appropriations	23,775,155
Surplus of estimated revenue (1915), if bonds are issued to provide for Panama Canal	$10,763,489

METHODS OF DIRECT LEGISLATION IN OREGON.

By William F. Ogburn, *Reed College, Portland, Ore.*

The success or failure of direct legislation is usually judged either by the kind of laws passed or by the effect of the law-making process on the citizens. It is usually admitted that in Oregon a large number of laws fulfilling valuable social ends have been passed through the medium of the initiative and the referendum. Indeed, the body of laws, known as the "Oregon System" is the direct result of the initiative and the referendum. It is also admitted that the people of Oregon have become comparatively well educated in governmental and legislative matters as a result of their experience in popular law-making during the past decade.

These two somewhat broad and simple criteria are concerned with the result, whereas the student is also interested in the methods of obtaining these results. A study of the methods furnishes one a somewhat more intimate knowledge than a study of results alone. The manner in which voters use these popular law-making instruments is still a matter of controversy, however. For instance, some observers state that voters of Oregon object to lengthy measures appearing on the ballot and vote them down; while others maintain that voters exercise their capabilities as well in voting on long measures as on short ones. Some other observations concerning which there is speculation are these: that bills calling for the expenditure of money are not passed; that the people will amend their constitution as readily as they will pass bills; that the people do not pass bills of only local interest; that the initiative is more successful at the polls than the referendum; that the publication and distribution of arguments with the measures, voted on previous to the election, increases the vote.

The settlement of questions such as the foregoing will throw considerable light on the capacity of the voters as law-makers. For instance, if it be established that long measures do not receive as large a vote as short ones and that short ones are

more readily adopted at the polls, the ability of the people as law-makers would thus seem to be limited.

The method of treating these questions, heretofore, has been personal impressions of observers. Such impressions are, in a large measure, subject to the personal traits of the observer, as, for instance, his capacity for seeing a thing and his personal opinions. This method yields little proof of accuracy for generalizations, but has furnished some interesting results in the nature of analyses of the measures voted on. This has been almost the only possible means of treatment, because the number of measures submitted to the voters has been too small to treat quantitatively. Now, however, Oregon citizens have been making laws for a decade and during that time have voted on 101 measures, a number large enough to yield some statistical results.

It is the purpose of this paper to endeavor to establish as facts, by quantitative measurements, matters now debatable. In doing this, it is also desired, as of equal importance, to describe more adequately the process of law-making in Oregon.

It is observed that most of the questions referred to above are questions of association. For instance, the question, whether short measures poll a larger vote than long ones, is really a question of association, the association of the length of the measure with the size of the vote polled. Are long measures associated with large votes? If this is true, then the question is answered. To arrive at a solution, then, the problem is to measure the degree of association. Such a measure of association can be found; this is called the coefficient of association;* and its nature is such that when there is complete association the coefficient becomes +1 and if there is no association the coefficient becomes 0. For instance, if long measures almost invariably poll large votes, the coefficient of association would be a fraction in the direction of +1. On the other hand, if there is disassociation, the coefficient varies con-

*This coefficient was formulated by Mr. G. Udny Yule. His treatment of it is found in the Journal of the Royal Statistical Society, Volume LXXV, Part VI, pp. 579–642. The coefficient here used is called ω, and in the terminology of the four-fold table, $\frac{a \mid b}{c \mid d}$ is equal to $\frac{1-\sqrt{k}}{1+\sqrt{k}}$, where $k = \frac{cb}{ad}$. The error of this coefficient, ϵ_{ω}, is equal to $\frac{1-\omega^2}{4}\sqrt{\frac{1}{a}+\frac{1}{b}+\frac{1}{c}+\frac{1}{d}}$.

tinously between 0 and −1. For instance, if long measures almost invariably poll small votes, the coefficient of association would be a fraction in the direction of −1. A further description and illustration of this method of measurement will be made in the treatment of the first question, which asks whether there is any association between the institutional nature of measures (bills and constitutional amendments), and decisions at the polls (adoptions and rejections).

Institutional Nature of Measures and Decisions at the Polls. Are bills adopted more readily than constitutional amendments? There have been 61 bills before the voters and 40 constitutional amendments. Of the bills, 24 were adopted and 37 were rejected. Of the constitutional amendments, 18 were adopted and 22 were rejected. The data may be arranged in tabular form as follows:

Institutional Nature of the Measures.	Decisions at Polls.		
	Adopted.	Rejected.	Total.
Bills	24	37	61
Constitutional Amendments	18	22	40
Total	42	59	101

The coefficient of association is found to be −0.06. This is so small,* however, that it does not show any association.

This conception of apparent indifference of voters to whether the measure is a constitutional amendment or a bill is further strengthened by the coefficient of association between the institutional nature of the measures (constitutional amend-

* The fact that the number of cases dealt with (101) is so small makes very great care in interpreting results necessary. Mr. Yule, in his Introduction to the Theory of Statistics, notes an illustration of the effect of small numbers on the result, seen from the tossing of coins in pairs, where 100 pairs gave the following results.

First toss heads and second heads	26
First toss heads and second tails	18
First toss tails and second heads	27
First toss tails and second tails	29

These data yield a coefficient of association, ω, equal to +0.11. Yet it is fairly certain that there is no such positive association, the result being due to chance.

The coefficient of association (−0.06), found from the data on the institutional nature of measures and decisions at the polls, has an error equal to 0.10. On the assumption of normal distribution the chances are even that the true ω in this case will be between 0 and −0.12, where as the chances are 22 to 1 against the true ω being outside the limits +0.12 and − 0.24. So in no case could the measure of association be very large.

ments and bills) and the sizes of the votes (large and small). In this case, the coefficient* is −0.11. Furthermore, constitutional amendments and bills are equally closely contested at the polls. The coefficient of association† is +0.10 as measured for the association between the institutional nature of the measures (constitutional amendments and bills) and the degree of contest at the polls (closely contested and not closely contested). Mr. Lowell's contention,‡ made seventeen years ago, that the referendum would tend to remove the distinction between constitutional and other laws, is strengthened by the evidence from Oregon.

The Sizes of the Votes. The ability of the people to make laws may be tested by the sizes of the votes cast on the measures at the elections. This may be done in two ways. First, the average vote from election to election may be compared; and, second, the nature of the frequency-distribution of the votes may be observed. With regard to the first point, decreasing averages for the five elections since the operation of the initiative and referendum would seem to indicate that the people's interest in law-making was on the wane, while increasing averages would seem to indicate increased interest. The procession of averages might also indicate fluctuations, such as we know people are liable to. To find the average vote at each election, beginning with 1904, would not yield the information desired, because it would not make allowance for the increase in population, which has been very great in Oregon in the past decade. To eliminate this factor of increase of population, a number has been computed for each election, which would have been the average vote on the measure if as many voters had gone to the polls in these election periods as went in 1912. For instance, in November, 1912, there were 144,113

* Any vote above the average vote (150,153), was considered large and below the average was considered small. How this average was determined is presented in the paragraph dealing with sizes of the votes. There have been 17 constitutional amendments and 33 bills receiving a large vote. There have been 23 constitutional amendments and 28 bills receiving a small vote.

† The closeness of contest is discussed under the paragraph dealing with the degree of contest at the polls. The differences between the vote for and the vote against a measure indicates the closeness of the contest. All above this average difference (31,785) were considered not closely contested and all below the average were treated as closely contested.

There were 26 constitutional amendments closely contested and 14 not closely contested. There were 24 bills closely contested and 27 not closely contested.

‡ Lowell, Governments and Political Parties in Continental Europe, Vol. II, p. 297.

citizens who voted, and the average vote on the measures was 106,818. (Candidates and measures have been voted on at the same elections.) In November, 1910, there were 120,248 citizens who voted and the average vote on the measures was 85,148. Whereas, if there had been 144,113 voters in 1910, the average vote on the measures would have been, on this basis, 102,177. The corrected averages, then, for the election periods in 1904, 1906, 1908, 1910 and 1912 are respectively, 113,205, 108,442, 106,917, 102,177, and 106,818.*

	1904.	1906.	1908.	1910.	1912.
Average votes on measures	78,075	74,098	86,224	85,148	106,818
Number of citizens voting at polls	99,315	99,445	116,614	120,248	144,113
Percentages; average vote of number voting................	0.78	0.74	0.74	0.71	0.74

In interpreting these averages it should be borne in mind that the number of measures voted on at each of the respective election periods is 2, 11, 19, 32, and 37. Perhaps the most striking observation to be made from these data is the constancy of the average, showing that the interest of the voters in law-making is constant.

The nature of the frequency-distribution of the votes on the measures is shown in Figure 1. It is seen to be a distribution where there are few measures polling large votes, few measures polling small votes and many measures polling votes near the average in number. In fact, for such a small number of cases, the form of the distribution approaches very closely the normal curve. If there had been many measures on which the votes were large, and many measures on which the votes were small, the situation would have been similar to that of votes for party candidates for offices, where there are large parties and small parties. If such a distribution existed for the votes on measures it would indicate some unusual force at work, as for instance, parties, as an explanation of the extreme fluctuation of interest of the voters. However, the frequency distribution seems to be normal. It is interesting that meas-

* Another method of getting at the desired information would be to find what percentage the average vote at each election is of the total number of citizens who voted. This information, disclosed in the following table, leads to the same general result as was found by the corrected averages.

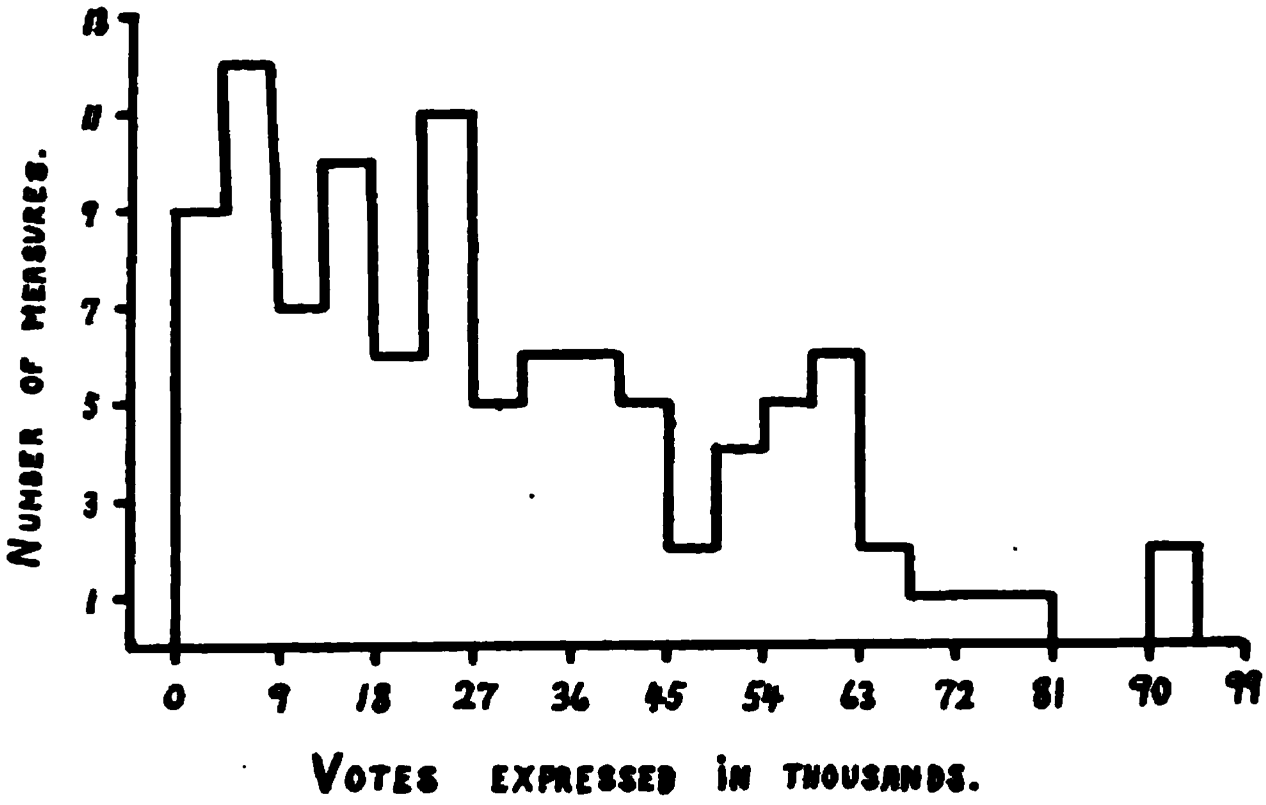

Fig. 1.—Frequency-distribution * of votes on initiative and referendum measures voted on in Oregon during the decade, 1903–1913.

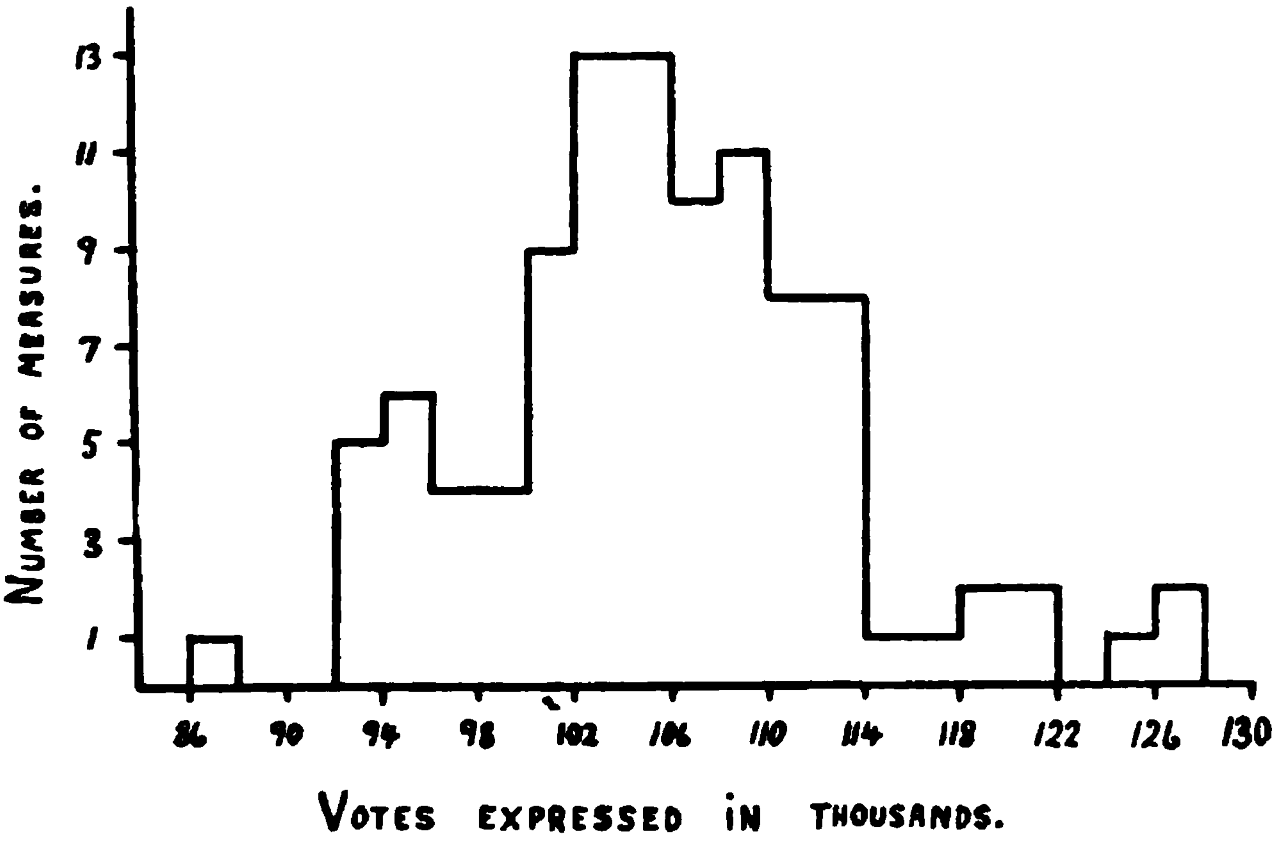

Fig. 2.—Frequency-distribution of the votes by which initiative and referendum measures won and lost in Oregon during the decade, 1903–1913. This indicates the distribution of the measures according to the degree that they are closely contested.†

* It is remembered that the votes cast occur over a series of years. To make a frequency-distribution, then, it becomes necessary to eliminate the factor of increase of population. This was done for each measure as it was done in treating averages, which is shown in the first paragraph dealing with the sizes of the votes.

† In obtaining the figures on which Figure 2 is based, allowance was made for the increase in population, as in the treatment of the average votes.

ures regarding the sale of liquor and woman-suffrage amendments have polled the largest votes. The vote has also been large on some single-tax measures. Bills regarding the creation of new counties have polled the smallest votes.* There have also been some tax measures that have polled small votes.

The variation in the sizes of the votes cast on measures furnishes evidence regarding the capacity of the people to make laws. For instance, if the vote on each measure is very nearly the same, it will indicate a lack of discrimination in interest on the part of the people. For the data serving as the basis of Figure 1, the measure of variability, the standard deviation, is 7,531 and the coefficient of variation $\left(\frac{\delta}{A}\right)$, is 0.07, thus showing that there is discrimination of interest on the part of the people in regard to the measures submitted to them.

The Degree of Contest at the Polls. To what extent the measures are closely contested would seem to be related to the intelligence of the voters and to the nature of the laws submitted to the people to be voted on. If all measures were equally closely contested, there would seem to be either an almost unbelievable sameness of laws submitted, or else some extraordinary force in operation, as perhaps parties. If, on the other hand, there is much variation in the degree of contest on the measures, the voters would seem to be using discretion. In speaking of a closely contested measure, there is meant one where the difference between a vote for and a vote against a measure is small; and the difference between a vote for and a vote against a measure is the numerical expression for the degree of contest. Figure 2 shows the frequency-distribution of the votes indicating the degree of contest at the polls. It is to be observed that most of the measures are fairly closely contested; also that the variation in the degree of contest is quite great. The measure of this variation, the standard deviation, is 21,807 and the coefficient of variation, $\left(\frac{\delta}{A}\right)$, is 0.68. This is a very high degree of variation and shows considerable discrimination on the part of the voters. The most closely contested measure was an income tax measure, and the least

closely contested measure was a measure providing for a gross-earnings tax on express, telephone, and telegraph companies.

Methods of Submitting Measures and Decisions at the Polls. The question has arisen, Do the citizens, in voting, discriminate between an initiative measure and a referendum measure with regard to willingness to adopt or to reject? If they do, it tends to show a particular care for these methods; if not it would tend to show that attention is focused on the nature of the bill, rather than the nature of its presentation. Of the initiative measures submitted to the voters, 33 have been adopted and 43 have been rejected; 9 referendum measures have been adopted and 16 referendum measures have been rejected. These data show the coefficient of association to be +0.08, the measure of association between the methods of submitting measures (initiative and referendum) and the decisions at the polls (adoption and rejection). There is no indication from this evidence, then, that it makes any difference to the voters whether the measure is submitted by initiative or referendum.

Money-Bills and Decisions at the Polls. It has been frequently said that the people in Oregon will not adopt bills providing for the expenditure of money. Are the people conservative in spending money? If they are, then how much so? In collecting data on this question, it was first necessary to determine what bills provided for the expenditure of money. In order to do this there was used the conception that a money-bill is one authorizing the expenditure, or the power to expend, money of the general state more than an insignificant sum in amount; this authorization being fairly easily recognizable from the text or the title of the measure. There is still some difficulty in making this classification certain. In the appendix to this paper will be found a list of the bills declared money bills. In other cases, where the classification was doubtful, the appendix will indicate the choices made. Of the bills not providing for the expenditure of money, 34 were adopted and 39 were rejected. Of the money-bills, 8 were adopted and 20 were rejected. These yield a coefficient of +0.19; the probable-error of this coefficient is 0.08. It is probable then from the Oregon experience that money-bills are more readily re-

jected than adopted, though this tendency is not carried to any great degree. However, money-bills are not associated with any larger vote nor are they more closely contested as the two coefficients* in these two cases are respectively +0.007 and +0.07.

Sizes of the Votes and Decisions at the Polls. The measures that are adopted do not draw larger votes nor are they more closely contested than those rejected. The respective coefficients† of association are +0.11 and +0.04. These coefficients seem to indicate that the voters are as interested in rejecting a measure as they are in adopting it; also that they will decide on a measure by a large margin as readily as by a small margin.

Local or General Nature of Measures and Decisions at the Polls. Several times there have appeared on the ballot bills which citizens refer to as local in nature. And by "local in nature" is not meant a bill which is voted on only by a single county or locality; but one that is voted on by the whole state, but applying with particular emphasis to some special locality. An illustration is a measure establishing a normal school at a specified place; another, one changing the boundaries of a county. It is, of course, not always easy for the classifier to say when a bill is local in nature or general. For instance, the appropriation for a building at the state university was classified as a bill general in nature. It is argued that the people ought to vote only on measures general in nature, and leave those measures necessarily local in nature to be handled by the state legislature. If the people consider the appearance of measures, local in nature, on the ballot, an abuse of direct legislation and think that such measures ought to be handled by the state legislature, there will be an association between local measures and rejection at the polls. This is probably

* Of the money-bills, 14 received a large vote and 14 received a small vote. Of the non-money-bills, 36 received a large vote and 37 received a small vote.

Of the money-bills, 18 were closely contested and 10 were not closely contested; of the non-money-bills, 24 were closely contested and 31 were not closely contested.

† Of the measures adopted, 24 received large votes and 19 received small votes. Of the measures rejected, 26 received large votes and 32 received small votes.

Of the measures adopted, 26 were closely contested and 16 were not closely contested. Of the measures rejected, 34 were closely contested and 25 were not closely contested.

true, as the coefficient of association* is +0.13. Such association seems to be only very slight, however. If the people objected to the use of the ballot for measures local in nature, these measures would not be closely contested. They are not. For the association of the nature of the measures (general and local) with the degree of contest at the polls (closely contested and not closely contested) the coefficient † is +0.21. Here again, however, the association is not very great. Furthermore, measures, local in nature, draw smaller votes; the coefficient of association‡ is +0.26. (Of the 19 measures classified as local in nature, 10 had to do with either creating new counties or changing county boundaries.) If the interpretation of the meaning of these coefficients is correct, then the people probably feel moderately that the legislature should decide on measures, local in nature.

Publications of Arguments and Sizes of Votes. A pamphlet (or book as the case may be), containing a text of the measures to be voted on is mailed to each voter by the secretary of state just prior to the election. Provision has been made for publishing in this pamphlet, after each measure, arguments for or against the particular measure or both, submitted by interested persons or organizations. The use of space in this pamphlet is optional; as a result there are many cases where it is not used. The question arises, Does this publication of arguments stimulate the vote? In endeavoring to answer this question, it is desirable to measure the association between the publications of arguments (arguments for or against, or both, and no arguments), and the sizes of the votes (large and small). This has been done and the coefficient of association § is +0.01, thus indicating that the publication of arguments is not associated with large votes. This may not mean that the publication of arguments has not stimulated votes; as those measures of

* Of the measures, general in nature, 36 were adopted and 46 were rejected. Of the measures, local in nature, 6 were adopted and 13 were rejected.

† Of the measures, general in nature, 52 were closely contested and 30 were not closely contested. Of the measure, local in nature, 8 were closely contested and 11 were not closely contested.

‡ Of the measures, general in nature, 45 polled a large vote and 37 polled a small vote. Of the measures, local in nature, 5 polled a large vote and 14 polled a small vote.

§ Of these measures, published with arguments either for or against a measure, or both, 32 received a large vote and 32 received a small vote. Of these measures published without argument, 18 received a large vote and 19 received a small one.

widest general interest may have been especially selected as not needing the publication of arguments. Familiarity with the pamphlets, however, leads one to think that there is hardly such a selection.

Publications of Arguments and Decisions at the Polls. Does the publication of an argument against a measure help its defeat? Does the publication of an affirmative argument materially assist in the passage of the measure? Taking up for consideration the first question, the comparison is only between those measures with a negative argument on the one hand and, on the other hand, those measures without arguments and those with arguments both affirmative and negative. Those measures with an affirmative argument only are not included in the data for this problem. Of the measures with only a negative argument, 11 were rejected at the polls and 1 was adopted. Of those measures with no argument and of those with both negative and affirmative arguments, 32 were rejected and 33 were adopted. These yield a coefficient of association equal to +0.54 with a probable-error of 0.12. Thus arguments against measures are associated with their rejection.

The question next to be considered is, Does the publication of an affirmative argument assist in the passage of the bill? The data used in determining the answer to this question consist of those measures published with only an affirmative argument on the one hand, and, on the other hand, those published without any argument and those published with both negative and affirmative arguments. Those measures published with only a negative argument are not included in the data for this problem. Of those measures with only an affirmative argument, 7 were adopted and 15 were rejected. Of those measures with no arguments and those with both negative and affirmative arguments, 32 were adopted and 32 were rejected. These data show a negative association between the publication of an affirmative argument and adoption at the polls. The coefficient is −0.19 with a probable-error of 0.08. The chances are, then, that an affirmative argument is slightly associated with rejection at the polls. The significance of these somewhat curious results is hard to surmise. It seems though that

an argument for a measure is at least not associated with its success at the polls, while an argument against a measure seems definitely to be associated with its failure at the polls.

The Length of Measures and Decisions at the Polls. To know the length of the measures that have been submitted to the voters of Oregon through the medium of the initiative and referendum is important. It has been often remarked that the measures are too long. It is interesting, then, to observe that one half of the measures submitted are less than 400 words long, less than a page in length. Of the 101 measures submitted to the voters, 18 are less than 100 words in length and 36 are less than 200 words. Two thirds of the measures submitted are less than 800 words, or one and three fourths pages. However, there have been eight measures over five pages long and one of these contained more than a million words. In the measurement of the length of measures, all measures containing less words than the median, which was 400 words long, are called short measures and those measures of more than 400 words are considered long measures.

What is the degree of association between the length of measures and decisions at the polls? Do short measures tend to be adopted more readily? The coefficient of association * is +0.11 with a probable-error of 0.07. The chances are, then, that if there is any association between short measures and success at the polls it is so small as to be insignificant. The opinion that the voters are indifferent to the length of the measures is further strengthened by the coefficient of association between the sizes of the votes (large and small) and the length of measures (short and long). The coefficient of association† is +0.03. The association is so small as to be insignificant, and the length of the measures has nothing to do with the sizes of the votes.

Agencies of Public Opinion and Decisions at the Polls. The investigation, so far, has shown that the influences of certain forces on the voters, often considered to be strong are either negative or exist only to a small degree. This suggests that

* Of the short measures, 26 received large votes and 25 received small votes. Of the long measures, 24 received large votes and 26 received small votes.

† Of the short measures, 24 were adopted and 27 were rejected. Of the long measures, 18 were adopted and 32 were rejected.

the quality of the measures is the big determining force exerted upon the voters. This raises the question, as to what guidance exists for the voters in the matter of the quality of the measures and to what extent these respective guiding agencies really influence the voters. There are, of course, many such guiding agencies, the press, organizations, speakers, publications of literature. To measure the influence of each of these agencies is difficult. Only two such influences seem to admit of quantitative measurement; one is the influence of a newspaper, the *Oregonian*, and the other the influence of a civic organization, the Taxpayers' League. It has been the practice, during the later election periods, for these two institutions to publish prior to election day their recommendations to the voters on each measure. This is usually done by analyzing the measures and by giving reasons. These are eventually condensed to a recommendation of yes or no, and printed in a column sufficiently small to be taken to the polls by the voter. This practice has been in existence only since the number of measures submitted to the voters has been large; and there are some measures upon which there is no recommendation. This, of course, makes the numbers very small for statistical treatment.

The *Oregonian* has made 68 such recommendations and 39 of these have been the same as the decisions of the voters at the polls, making a coincidence in 57 per cent. of the instances. Of their recommendations for adoption, 8 measures were adopted and 12 were rejected. Of their recommendations for rejection 17 measures were adopted and 31 were rejected. The coefficient of association is +0.05; not significant. The Taxpayers' League has made 41 such recommendations and 31 of these have been the same as the voters' decisions, making a coincidence in 76 per cent. of the instances. Of their recommendations for adoption, 10 were adopted and 8 were rejected. Of their recommendations for rejection, 2 were adopted and 21 were rejected. The coefficient of association is +0.57 with a probable error of 0.10. This seems to indicate an association between the recommendations of the Taxpayers' League and the decisions of the voters at the polls. However, it should be

remembered that the number of cases is so small as to make the interpretation coefficients not certain.

To avoid the difficulty of such small numbers of cases, the data has been broadened to include city (Portland) measures, in addition to the state measures. Portland is the largest city of Oregon and possesses nearly one third of the population of Oregon. Portland has had a local initiative and referendum law since 1906. The seat of both the *Oregonian* and the Taxpayers' League is in Portland. If both city and state measures are included, the *Oregonian* has made 101 recommendations, 65 per cent. of which have coincided with the decisions of the voters. The coefficient of association* is +0.23 with a probable error of 0.10. Including both city and state measures, the Taxpayers' League has made 134 recommendations, 70 per cent. of which have coincided with the decisions of the voters. The coefficient of association† is +0.48. The interpretation of these data, then, leads to the conclusion that these two institutions exert a real influence on the decisions at the polls; the influence of the Taxpayers' League being somewhat stronger.

Conclusions. With regard to the results of this investigation, the associations measured stand as facts, subject, of course, to the probabilities due to the small number of cases. These are sufficiently indicated by the sizes of the coefficients and their errors. If the interpretation of the meaning of the coefficients extends further than the established associations, it becomes dependent on the meaning of the data, and varies according to personal interpretations. The range and possibility of this variation is not great, owing to the quantitative measurements. Remembering this, the results of this investigation may be summed up as follows:

It makes no difference to the voters at the polls whether a measure is a constitutional amendment or a bill.

The interest of the people in law-making has not diminished nor increased nor fluctuated. It has been constant and steady.

* Of the city and state measures recommended for adoption by the Oregonian, 17 were adopted and 16 were rejected. Of those recommended for rejection, 20 were adopted and 48 were rejected.

† Of the city and state measures recommended for adoption by the Taxpayers' League, 45 were adopted and 31 were rejected. Of those recommended for rejection 9 were adopted and 49 were rejected.

The interest of the voters, as shown by the sizes of the votes, is normal and shows no large and unusual force at work.

The variation of the sizes of the votes shows that the voters use discrimination in voting.

More measures are closely contested than not and the large amount of variation in the degree to which the measures are contested shows very decidedly that the voters use discrimination.

It makes no difference to the voters at the polls whether the measure is an initiative measure or a referendum measure.

Voters reject money-bills more readily than bills not calling for the expenditure of money. This tendency is very slight, however.

Voters are as interested in rejecting and adopting a measure vigorously as they are in passing a closely contested measure.

The people are less interested in measures, local in nature, and the chance of such a measure passing is not quite so good as a measure, general in nature. This may be interpreted as meaning that the people have a slight preference for the action of the state legislature on measures, local in nature.

The publication and distribution of arguments with the measure submitted does not increase the vote.

The publication of negative arguments alone and of affirmative arguments alone are associated with defeat at the polls.

The tendency is to submit short measures to the voters.

It makes no difference to the voters at the polls whether a measure is a long one or a short one.

The publication of recommendations by two agencies of public opinion influences the voters, but not to any very great extent.

The above-mentioned inflences on the voter, often considered strong, exist if at all only in a small degree. The big determining force on the voters is the quality of the measures.

APPENDIX.

Initiative and Referendum Measures Voted on in Oregon.

KEY.

(A) Constitutional amendment.
(a) Bill.
(B) Initiative measure.
(b) Referendum measure.
(C) Measure providing for expenditure of money.*
(c) Measure not providing for expenditure of money.
(D) Measure general in nature.*
(d) Measure local in nature.
(E) Long measure.*
(e) Short measure.
(F¹) Measure published with an affirmative argument.*
(F²) Measure published with a negative argument.
(F¹²) Measure published with an affirmative and a negative argument.
(f) Measure published without an argument.
(G) Measure the adoption of which was recommended by the *Oregonian*.*
(g) Measure the rejection of which was recommended by the *Oregonian*.
(H) Measure the adoption of which was recommended by the Taxpayers' League.*
(h) Measure the rejection of which was recommended by the Taxpayers' League.

		Yes.	No.
	General Election, June 6, 1904.		
(aBCDEf)	Direct Primary Nominating Elections Law†	56,205	16,354
(aBcDEf)	Local Option Liquor Law	43,316	40,198
	General Election, June 4, 1906.		
(abCDef)	General appropriation bill, State Institutions	43,918	26,758
(ABcDeF¹²)	Equal Suffrage Amendment	36,902	47,075
(aBcDEf)	Amendment to Local Option Liquor Law	35,297	45,144
(aBCdef)	Purchase of Barlow toll road by State	31,525	44,527
(ABcDef)	Requiring referendum on any act calling a constitutional convention	47,661	18,751

* The definitions of the different kinds of measures indicated by the key will be found in the text of the article to which this is an appendix.

† The order of the listing of the measures is the same as appeared on the ballot.

The titles of the measures presented here are abbreviated. This was done by the Secretary of State of Oregon.

(ABcDef)	Giving cities sole powers to amend their charters	52,567	19,852
(ABcDef)	Authorizing State Printer's compensation to be regulated by law at any time	63,749	9,571
(ABcDef)	Initiative and referendum to apply to all local, special and municipal laws	47,678	16,735
(aBcDef)	Prohibiting free passes on railroads	57,281	16,779
(aBcDEf)	Gross earnings tax on sleeping, refrigerator and oil car companies	69,635	6,441
aBcDEf)	Gross earnings tax on express, telephone and telegraph companies	70,872	6,360
	General Election, June 1, 1908.		
(AbCDefg)	To increase compensation of legislators from $120 to $400 per session	19,691	68,892
(AbcDefg)	Permitting location of State Institutions at places other than at the State Capital	41,971	40,868
(AbCDEfH)	Reorganizing system of Courts and increasing the number of Supreme Judges from three to five	30,243	50,591
(AbcDefgH)	Changing date of General Elections from June to November	65,728	18,591
(abcDef)	Giving sheriffs control of county prisoners	60,443	30,033
(abcDEF^2gh)	Requiring railroads to give public officials free passes	28,856	59,406
(abCDeF^1h)	Appropriating $100,000 for building armories	33,507	54,848
(abCDeF^{12}GH)	Increasing annual appropriation for University of Oregon from $47,500 to $125,000	44,115	40,535
(ABcDeF^{12})	Equal Suffrage	36,858	58,670
(aBcdEF^{12}g)	Fishery law proposed by fish wheel operators	46,582	40,720
(ABcDeF^{12}gh)	Giving cities control of liquor selling, pool-rooms, theatres, etc., subject to Local Option Law	39,442	52,346
(ABcDeF^1gh)	Modified form of single tax amendment	32,066	60,871
(ABCDEfg)	Recall power on public officials	58,381	31,002
(aBcDefg)	Instructing legislators to vote for the people's choice for United States Senator	69,668	21,162
(ABcDefg)	Authorizing proportional representation law	48,868	34,128

(aBcDEF^{1}g)	Corrupt practices Act governing elections	54,042	31,301
(aBcdeF^{12}g)	Fishery law proposed by gill-net operators	56,130	30,280
(ABcDeF^{1}gH)	Requiring indictment to be by grand jury	52,214	24,487
(aBcdEF^{1})	Creating Hood River County	43,948	26,778
	General Election, November 8, 1910.		
(ABcDeF^{12}g)	Permitting female taxpayers to vote	35,270	59,065
(abCdEF^{1}G)	Establishing branch insane asylum in eastern Oregon	50,134	41,504
(abCDEF^{2}G)	Calling convention to revise State Constitution	23,143	59,974
(AbcDeF^{2}G)	Providing separate district for election of each State Senator and representative	24,000	54,252
(AbcDeF^{1}g)	Repealing requirement that all taxes shall be equal and uniform	37,619	40,172
(AbCDEF^{1}g)	Permitting organized districts to vote bonds for construction of railroads by such districts	32,844	46,070
(AbcDefg)	Authorizing collection of State and County taxes on separate classes of property	31,629	41,692
(abCdefG)	Requiring Baker county to pay $1,000 a year to Circuit Judge in addition to his State salary	13,161	71,503
(aBcdEF^{1}g)	Creating Nesmith County from parts of Lane and Douglas	22,866	60,951
(aBCdeF^{1})	To establish a State Normal School at Monmouth	50,191	40,044
(aBcdEF^{1}g)	Creating Otis County from parts of Harney, Malheur and Grant	17,426	62,016
(aBcdEF^{12}g)	Annexing part of Clackamas County to Multnomah	16,250	69,002
(aBcdEF^{1}g)	Creating Williams County from parts of Lane and Douglas	14,508	64,090
(ABcDefg)	Permitting people of each county to regulate taxation for county purposes and abolishing poll taxes	44,171	42,127
(ABcDeF^{12})	Giving cities and towns exclusive power to regulate liquor traffic within their limits	53,321	50,779
(aBcDEF^{1}g)	For protection of laborers in hazardous employment, fixing employers' liability, etc	56,258	33,943

(aBcdEF^{12}g)	Creating Orchard County from part of Umatilla	15,664	62,712
(aBcdEF^{1}g)	Creating Clark County from part of Grant	15,613	61,704
(aBCdeF^{1})	To establish State Normal School at Weston	40,898	46,234
(aBcdeF^{2}g)	To annex part of Washington County to Multnomah	14,047	68,221
(aBCdEF^{1})	To establish State Normal School at Ashland	38,473	48,655
(ABcDeF^{12}g)	Prohibiting liquor traffic	43,540	61,221
(aBcDEF^{12}g)	Prohibiting sale of liquors, and regulating shipments of same, and providing for search for liquors.	42,651	63,564
(aBcDEF^{1})	Creating board to draft employers' liability law for submission to legislature	32,224	51,719
(aBcdeF^{12}g)	Prohibiting taking of fish in Rogue River except with hook and line	49,712	33,397
(aBcdEF^{12}g)	Creating Des Chutes County out of part of Crook	17,592	60,486
(aBcDEF^{1}g)	Bill for general law under which new counties may be created or boundaries changed	37,129	42,327
(ABCDeF^{1}G)	Permitting counties to vote bonds for permanent road improvement	51,275	32,906
(aBCDEF^{12}g)	Permitting voters in direct primaries to express choice for President and Vice-President, to select delegates to national conventions, and nominate candidates for presidental electors	43,353	41,624
(aBCDEF^{12}g)	Creating board of people's inspectors of government, providing for reports of board in official State Gazette to be mailed to all registered voters bimonthly	29,955	52,538
(ABcDEF^{12}g)	Extending Initiative and Referendum, making terms of members of legislature 6 years, increasing salaries, requiring proportional representation in legislature, election of speaker of house and president of senate outside of members, etc.	37,031	44,366
(ABcDEfg)	Permitting three fourths verdict in civil cases	44,538	39,399
	General Election, November 5, 1912.		
(ABcDeF^{12}G)	Woman Suffrage Amendment	61,265	57,104

(AbCDeF^{1}GH)	Creating office of Lieutenant Governor	50,562	61,644
(AbcDeF^{12}GH)	Divorce of local and state taxation...	51,852	56,671
(AbcDeF^{12}GH)	Permitting different tax rates on classes of property	52,045	54,483
(AbcDeF^{12}GH)	Repeal of County tax option........	63,881	47,150
(AbcDeF^{2}h)	Majority Rule on constitutional amendments	32,934	70,325
(AbcDefGH)	Double liability on bank stockholders	82,981	21,738
(abcDEF^{2}GH)	State-wide public utilities regulation	65,985	40,956
(aBcdEF^{12}g)	Creating Cascade County..........	26,463	71,239
(aBCDEF^{12}GH)	Millage tax for University and Agricultural College—Simple tax law..	48,701	57,279
(ABcDEF^{12}h)	Majority Rule on initiated laws.....	35,721	68,861
(aBCDEF^{1}h)	County bonding and road construction act,—Grange Bill..........	49,699	56,713
(aBCDEF^{1}h)	Creating State Highway Department —Grange Bill	23,872	83,846
(aBcDeF^{2}gh)	Changing date State Printer Bill Became effective	34,793	69,542
(aBCDEF^{2}gh)	Creating office of Hotel Inspector....	16,910	91,995
(aBcDEfg)	Eight hour day on public works.....	64,508	48,078
(aBcDEF^{12}gh)	Blue Sky Law	48,765	57,293
(aBcDefgH)	Prohibiting private employment of convicts	73,800	37,492
(aBcDEfgH)	Relating to employment of county and city prisoners	71,367	37,731
(aBCDEfH)	State road bonding act............	30,897	75,590
(ABcDefH)	Limiting state road indebtedness....	59,452	43,447
(aBCDEfH)	County bonding act...............	43,611	60,210
(ABcDefH)	Limiting county road indebtedness...	57,258	43,858
(aBcDEfGh)	Providing method for consolidating cities and creating new counties....	40,199	56,992
(ABcDeF^{2}GH)	Income tax amendment...........	52,702	52,948
(aBcDEF^{12}Gh)	Tax exemption on household effects..	60,357	51,826
(aBcDeF^{12}gh)	Tax exemption on moneys and credits	42,491	66,540
(aBcDEF^{12}gh)	Revising inheritance tax laws.......	38,609	63,839
(aBcDEfgh)	Freight rates act.................	58,306	45,534
(ABCDEF^{1}h)	County road bonding act..........	38,568	63,481
(ABcDEF^{12}gh)	Abolishing Senate; proxy voting; U'Ren Constitution............	31,020	71,183
(ABcDEF^{12}gh)	State-wide Single Tax with graduated tax jug handle................	31,534	82,015
(aBcDefg)	Abolishing capital punishment......	41,951	64,578
(aBcDEF^{2}h)	Prohibiting boycotting............	49,826	60,560
(aBcDeF^{2}Gh)	Giving mayor authority to control street speaking..................	48,987	62,532
(abCDefGh)	Appropriation for University.......	29,437	78,985
(abCDefGh)	Appropriation for University.......	27,310	79,376

EDUCATION AND FECUNDITY.

By Nellie Seeds Nearing.

I. The Increase in the Higher Education of Women.

In the effort to analyze a popular prejudice or fallacy, an adequate investigation of facts is usually sufficient to reveal the origin of such prejudice in previously existing conditions which have altered so gradually with time, that society as a whole has hardly yet become aware of the change. In such a category we might include many of the fallacies concerning the position and faculties of women.

A hundred years ago, the higher education of women was an unheard of phenomenon. Women were intended to bear children. What need had they of an education! Marriages were then contracted at an early age, usually in the teens or early twenties, and as an advanced education precluded the possibility of an early marriage, it seemed to preclude possibility of marriage at all.

The average woman, therefore, who went to college in the early days of college training for women, was not the type who would have been apt to marry in any case. The first classes of college women consisted largely of the woman who had some special talent which she wished to develop and practice, the woman of strong intellectual proclivities, who preferred not to engage in the domestic occupations usually relegated to women, and the woman who, because of personal unattractiveness, knew or feared her lack of popularity among men.

The later experiences of women's colleges are quite the opposite of those early encountered. Today it is the normal, not the unusual girl who goes to college or technical school. College education is considered generally desirable as a means of finishing the education of the average woman. It gives culture. It has become a common comfort, if not a necessity, for young women of means.

The developments of the last twenty years have placed before the parents of all classes a powerful incentive to give

their daughters the best in education that can be secured. Are parents today recognizing these facts and educating their daughters as well as their sons? What are the facts? After they have been ascertained, the second question may be asked —Does this increase of education have any appreciable effect upon fecundity?

The facts point conclusively to a rapid advance in the higher education of women. In the first place a larger number of girls than of boys are being given a high school education in the cities of the United States. Among 318 cities of the United States, 132 having 25,000 population and over, 186 having less than 25,000 population, twenty report more boys than girls in the fourth year of the high school. These twenty, moreover, are small and comparatively unimportant. In all the other 298 cities the number of girls is uniformly greater than that of boys.*

Although the number of girls in the high schools almost universally exceeds the number of boys, the situation in the elementary grades is the reverse. A school census of thirty-two states (1911) shows that in only one state—New Hampshire—were there more girls than boys in all grades of the schools†. In only eight out of these thirty-one states, however, did the difference between the number of boys and number of girls exceed 10,000. The school system in its entirety contains a higher proportion of boys than of girls. It is only in the high school grades that the number of girls exceeds the number of boys. Clearly then, girls are availing themselves more fully of the public higher educational opportunities than are boys.

The real extent of the entrance by women into the fields of higher education is shown by a study of the statistics of college students. The movement toward the college education of women is so recent, and the opportunities for such education so much smaller than for that of men, that some years must still elapse before the absolute number of girls in college ap-

* Age and grade census of Schools and Colleges, G. D. Straker, United States Bureau of Education Bulletin 1911, No. 5, pp. 14–28.

† Report of United States Commissioner of Education, 1911–1912, Government Printing Office, 1913 Vol. 2, p. 93.

proaches the absolute number of boys there. The vital question therefore is the rate of increase in the number of women attending college each year and the rate of increase in the number of men. The figures are available between 1889–1912 for the number of men and women in colleges of the United States.* A comparison of these figures, first by ten year periods, then for the total period, shows that the ratio of increase is far greater for the women than for men.

TABLE I.

PER CENT. OF INCREASE IN THE NUMBER OF MEN AND WOMEN IN THE COLLEGES OF THE UNITED STATES, 1889–1912.

Period.	Men.	Women.
1890–1891 to 1900–1901	64	77
1900–1901 to 1910–1911	58	66
1889–1890 to 1911–1912	179	248

A further examination of the figures shows that the proportion of men to the total number of college students is steadily decreasing, and inversely the proportion of women steadily increasing.

TABLE II.

PROPORTION OF MEN IN COLLEGE TO TOTAL COLLEGE STUDENTS, 1889–1912.

Period.	Per Cent.
1890–1891	68
1900–1901	66
1910–1911	64
1911–1912	63

Here then is an answer to the first question regarding the higher education of women. The number of women in the United States receiving higher education is absolutely and relatively increasing in the colleges, while in the high schools

* Total number of men and women in the colleges of the United States, 1889–1912. Report of the Commissioner of Education, 1911–1912, Government Printing Office, 1913, Vol. 2, p. 249.

1889–1890	44,926	20,874
1890–1891	46,220	22,036
1900–1901	75,472	38,900
1910–1911	119,026	64,546
1911–1912	125,750	72,703

the number of girl students actually exceeds the number of boy students. What effect, if any, has this general entrance of women into the fields of higher education upon the marriage and birth rates of the women? An answer, scientifically established, will put to rest popular prejudice and speculative theory.

II. Marriage Rates of Educated Women.

Marriage is the first element in fecundity which must be considered and investigated. Illegitimate births are few among the educated classes, and the statistics of such births even in the population at large, never exact, probably do not even approximate the truth. Hence this discussion will ignore the whole question of illegitimacy, and consider marriage as the necessary precursor to motherhood.

The method adopted in obtaining the statistics of marriage among college women was as follows: From a list of all the colleges in the United States, classified according to states, in the report of the United States Commissioner of Education for 1911–1912, showing in all 459 colleges having women students, seventy-two colleges were selected from twenty-eight states, an effort being made to select those having the largest number of women students. The women in these colleges are representative, both territorially and numerically, of the college women of the United States. The colleges were selected from various localities. The total number of women students in these seventy-two colleges was 40,653 or 36 per cent. of the total number of women college students in the United States.

A form letter was written to the registrar of each of these colleges asking for any vital statistics which had been collected, or which might be available in any form. Twenty-nine colleges replied that no such statistics were available, 18 sent no reply, and 25 colleges sent such information as they had, which information in 7 cases proved of no value. The material at hand was then carefully gone over and compiled into marriage rate and birth rate tables for each college.

The marriage tables for each college were then combined into two tables giving by decades first the number and second the per cent. of married and unmarried graduates from 18 colleges having a total of 14,551 women graduates.

TABLE III.

* NUMBERS OF WOMEN GRADUATES AND NUMBER OF SUCH GRADUATES MARRIED FOR CERTAIN COLLEGES, BY COLLEGE AND BY DECADES, 1870–1913.

College.	1870–79.		1880–89.		1890–99.		1900–09.		1910–12.		Total to 1912.	
	* Number Graduate.	Number Married.	Number Graduate.	Number Married.	Number Graduate.	Number Married.	Number Graduate.	Number Married.	Number Graduate.	Number Married.	Number Graduate.	Number Married.
Earlham.....	23	13	43	33	132	80	200	103	15	10	473	239
Swarthmore..	31[4]	21	72	42	148	86	260	103	109	4	620	262
Wilson......	36	20	42[2]	23	219	123	309	95	140	2	746	266
Indiana.....	35	30	56	40	228	126	482	164			887	366
Vassar......	383	203	376	208	791	120	1,874	500			3,424	1,287
Oregon......			34	19	84	523	151	63			269	136
Radcliffe....			30	12	253	37	746	228	228	16	1,257	376
Wellesley....			318	257	1,201	123					1,719	780
South Dakota					47	3	733	33	23	5	153	84
Bryn Mawr .					294	158	688	244			1,193	392
Mississippi...			12[5]	7	10		48	8			70	18
Holyoke.....	†				377							
Washington State......							82	34	83	13	174	56
Rochester....							135[3]	30			135	40
Ohio........											52	32
Oregon Agricultural....											398	206
Rockford....											237[6]	134
Smith.......											2,161[6]	1,016

TABLE IV.

PER CENT. OF WOMEN COLLEGE GRADUATES WHO MARRIED, FOR CERTAIN COLLEGES, BY COLLEGES AND BY DECADES, 1870–1913.

College.	1870–79.	1880–89.	Per Cent. of Graduates Married.			Total Graduates to 1912.
			1890–99.	1900–09.	1909–12.	
Earlham....................	56.9	76.7	60.6	51.5	13.3	50.5
Swarthmore.................	67.7	58.3	58.7	39.6	3.6	42.2
Wilson.....................	55.5	54.7	56.1	30.7	1.4	35.6
Indiana....................	85.7	71.4	55.2	34.9		41.2
Vassar.....................	53.0	55.3	47.5	26.6		37.5
Oregon.....................		55.8	64.2	41.7		50.5
Radcliffe..................		40.0	47.4	30.5	7.0	29.9
Wellesley..................		49.6	43.5			45.3
South Dakota...............			78.7	21.7		54.9
Bryn Mawr..................			41.8	35.4		32.8
Mississippi................		58.3	30.0	16.6		25.7
Holyoke....................			41.9[1]	23.6[3]		
Washington State...........				41.4	15.6	32.1
Rochester..................				22.2		22.2
Ohio.......................						61.5
Oregon Agricultural........						51.7
Rockford...................						56.1
Smith......................						47.0

* Since 1873. [2] Since 1883. [3] Since 1901–10. [4] Since 1873. [5] Since 1885. [6] To 1901.

† Secured from an article by Amy Hewes, Quarterly Publication of American Statistical Association, Vol. XII, p. 771.

In only five cases were figures available for the decade 1870–79. In only nine cases were they available from 1880–89. In view of the fact, further, that the marriage rate of those graduating since 1900 would still necessarily be low because such graduates would be under 35 years of age, the most representative decade under consideration would be that from 1890–99. Here the absolute number of women graduates is greater than in any preceding decade, although less than in any succeeding decade. The per cent. of marriage here averages, on the whole, considerably lower than that of the previous decades in the colleges from which such information is available. It is probable, therefore, that the per cent. in this decade would give a conservative estimate of the rate for college women. It varies from 78.7 in South Dakota State College to 30 per cent. in the University of Mississippi—neither of these colleges being representative, graduating between them in the decade only 57 students. If we compare the per cent. for this decade with that of the following, we find an average fall of 20 while the average fall from the per cent. of 1900–09 to that which was estimated in a few cases for 1909–1912 was 25 per cent.

The totals are comparatively meaningless. This statement applies to both the absolute number and to the proportion of graduates married. Both the total number of graduates married in each college (and in some colleges this was the only information available), and the proportion married must be considered in view of the fact that the results are obtained from a body of students of whom a large number have yet had little opportunity for marriage, and whose marriage rate when estimated separately was from 20 to 25 per cent. lower than that in the previous decade. It must be remembered, moreover, that as each graduating class is in almost every case larger than the preceding one, the denominator of the fraction is every year being increased at a greater rate than the numerator. On the other hand, this marriage per cent. of the entire number of graduates of a college includes in the older colleges those who have graduated in the decades previous to 1890, and whose marriage rate averages, where figures are obtainable, over 15 per cent. higher in 1880–89 than in 1890–99 and

5 per cent. higher in 1870–79 than in 1880–89. Balancing off the 20 and 25 per cent. fall in the rate from 1890 to 1913, and 15 and 5 per cent. increase previous to 1890 and taking into account that the fall was for a far greater absolute number than the increase, because of the yearly increase in size of classes, we may assume that in cases where the marriage rate by classes was not obtainable, the rate for those graduating in the decade 1890–99 is at least 10 per cent. higher than the rate for the entire body of graduates.

The earliest years, as already indicated, are scarcely representative. Yet there seems to be little real difference between the percentages there and in later decades. Of the 9 colleges which supply us figures for the decade 1880–1889, 2 show percentages of married graduates in excess of 70 per cent. In neither of these colleges was the total number of graduates large (Earlham 43, Indiana 56). The other 7 colleges report marriage rates varying less than 10 points. The 2 large colleges, Vassar and Wellesley (376 and 518 graduates respectively), report a marriage rate for the decade of 55.3 in the case of Vassar and 49.6 in the case of Wellesley. The decade 1890 to 1899 is undoubtedly the most fairly representative of any of the decades under consideration. On the one hand, it falls within the epoch which accepted College Education for women, and looked upon it as thoroughly respectable. On the other hand, the graduates in the latest graduating class (class of 1899) are now at least 35 years of age. The marriage record of the decade is therefore fairly complete. The 8 colleges graduating more than 100 students during the decade (Earlham, Swarthmore, Wilson, Indiana, Vassar, Radcliffe, Wellesley, and Bryn Mawr) show fairly uniform marriage rates, the lowest is Bryn Mawr, 41.8 per cent. (294 graduates), and the highest is Swarthmore, 58.7 per cent. (148 graduates). It is probable that the marriage rate for this decade is fairly representative of the tendency in the modern women's college world. Granted that this statement is accurate, it may be said that the proportion of women college graduates who marry is approximately one half (usually slightly over 50 per cent.).

The records of the succeeding decade show a heavy falling off in per cent. of women married. The women in the class

of 1909 are approximately 25 years old. The marriage records are therefore incomplete and wholly unreliable. The proportion married for this decade is from one quarter to one third of the total graduates, and is therefore almost one half of the pupils reported for the previous decade.

This study was originally intended to study in three classes: (1) The college woman, (2) The normal school graduate, and (3) The commercial high school graduate, and to compare the marriage and birth rates prevailing among the three. With this end in view a form letter similar to that sent to the colleges was sent to leading high and normal schools throughout the country. Only six replies were received and in only 2 of these cases was any information vouchsafed. Obviously these figures were of no practical use.

The only other group educationally on a par with women college graduates, for whom statistics are obtainable, is the groups of men college graduates. The *Yale Review* gives us the following marriage rate for Yale graduates:

TABLE V.

PER CENT. OF YALE GRADUATES WHO WERE MARRIED, 1701-1886.

Classes.	Per Cent. Married.
1701-1791	88.3
1797-1833	78.8
1834-1849	81.2
1849-1866	81.3
1867-1886	66.3

The figures for the classes 1867–1886 are the only ones in any way comparable with the figures for woman college graduates. Since the question of social standing did not enter into the marriage rate of college men during the earlier decades, their marriage rate for the earliest decades would be expected to be somewhat higher than that of college women.

The only remaining comparison to be made is that between the marriage rate of college women and the marriage rate of the population at large.

TABLE VI.

PER CENT. MARRIED.* TOTAL NUMBERS AND PERCENTAGES OF WOMEN, 15 YEARS OF AGE AND OVER, TOGETHER WITH THOSE WHO ARE MARRIED AND WHO ARE SINGLE, 1910.

	Total.		Married.		Single.	
	Number.	Per Cent.	Number.	Per Cent.	Number.	Per Cent.
Total:						
Native white	30,047,325	100	21,045,983	70.0	8,933,170	29.7
Native parentage	15,523,900	100	10,842,998	69.8	4,644,122	29.9
Native white, foreign or mixed parentage	5,887,131	100	3,421,147	58.1	2,453,017	41.7
Foreign-born white	5,446,306	100	4,444,657	81.6	994,110	18.3
Negro	3,103,344	100	2,269,066	73.1	823,996	26.6

Since the great majority of women college graduates are native-born, the only figures here with which comparison can be made are those referring to native whites of native parents. As authority for this assumption, I might quote an investigation covering 1,290 college graduates in which 705 replied, practically all of whom were native born:

83.3 per cent. had native American parents.
2.8 per cent. had foreign mother and native father.
3.5 per cent. had foreign father and native mother.
only 9.8 per cent had both parents foreign born.

The following figures then stand contrasted:

Women 15 Years and Over.	*Per Cent. Married.*
(native white, native parents)	69.8 (figures taken 1910).
College graduates to 1913	42.2 (figures taken 1913).

In view of the fact that a small proportion of college graduates (about 15 per cent.) are of foreign or mixed parentage, and that the marriage rate for the population at large for native white women of foreign parentage is 58.1 per cent., hence lower than that for native white of native parentage, the 42.2 per cent. of college graduates should really be compared with a figure obtained by including 15 per cent. of those with foreign or mixed parentage, thus lowering the rate slightly. In other words, if

* Abstract of the Thirteenth Census.

we add to the 15,525,900 of native white parentage 15 per cent. of the 5,887,131 of mixed parentage, or 883,069 and to the 10,842,998 married of native white parentage, 58 per cent. (the foreign parentage rate) of this 883,069, or 158,925, we get a total of 11,001,950 women married out of total 16,406,969. This would give a marriage per cent. of 67. We can then make our contrast between 67 per cent. for the whole population and 42.2 per cent. for college graduates.

These figures show that the marriage rate for non-college women is 59 per cent. higher than the rate for college women. This would seem on the face of it, to be a tremendous difference, but it cannot be attributed solely to the difference in education. There are two other factors that play a large part in the situation. First comes the financial situation. In the second place, social considerations are of the utmost importance in determining marriage and usually act in actual practice as deterrents rather than incentives. The standards of living among educated people are higher, and their requirements harder for the prospective husband to meet. These two factors might and do contribute toward the comparatively low marriage rate of college women.

No other available figures throw light on the marriage rate, actual or comparative, of college women. College women do marry, probably in fifty cases out of a hundred, given sufficient time out of college.

III. Birth Rates of Educated Women.

Like the statistics of marriage, the most satisfactory statistics of the birth rate among educated women are those of college graduates. Out of the 58 replies from the 71 colleges written to, only 5 vouchsafed any information from which a birth rate could be deduced. In addition, information concerning 4 other colleges was obtained indirectly. Thus the source from which the figures were drawn is small in comparison with the entire field. The colleges included in it are, however, the most representative of American colleges for women. The following table gives a number of the most pertinent facts about the birth rates of college women:

TABLE VII.

MARRIAGE RATES AND BIRTH RATES OF COLLEGE GRADUATES.

College.	Time Covered.	Number of Graduates.	Married.		Those Married Having One Child or More.		Those Married Having Two Children or More.		Those Married Having No Children.		Absolute Number of Children.	Number of Children per 100 Graduates.	
			Number.	Per Cent.	Number.	Per Cent.	Number.	Per Cent.	Number	Per Cent		Total.	Married.
Rockford...	1870–1901	327	134	56.5	97	72.3	71	52.9	37	30.1	.	...	..
Smith.......	1870–1901	2,151	1,016	47.0	681	67.0	449	44.1	335	32.9			
Wellesley...	1875–1901	1,864	840	45.0	....	....	....	....	....	...	1,285	69.4	126.4
Vassar..	1867–1901	1,880	961	51.1	662	68.8	461	47.9	289	30.0	1,579	83.9	164.3
Bryn Mawr.	1890–1901	373	178	47.7	125	69.0	96	53.3	53	29.7	307	82.4	172.4
Holyoke	1890–1899	377	158	41.9							288	76.3	182.3
Smith...													
Bryn Mawr.													
Vassar...													
Wellesley.	1870–1901*	7,650	3,594	47.0	2,464	68.5	1,666	46.3	1,130	31.4	...	.	.
Wells........													
Radcliffe.													
Rockford													
Northwestern													

* Article of Mrs. Valentine in Smith Alumnae Quarterly, July, 1911, published by the Alumnae Association of Smith College.

From this table it appears that the per cent. of married college graduates having one or more children varies from 67 per cent. at Smith to 72.3 at Rockford College. In all cases the period covered is approximately the same (Bryn Mawr is the sole exception). In all cases the percentage by one or more children is remarkably uniform. The per cent. having two or more children varies from 44.7 at Smith to 53 at Bryn Mawr. The per cent. of married graduates having no children varies from 20.1 per cent. at Rockford to 32.9 per cent. at Smith. Thus we find the birth rate is lowest at Smith, highest at Rockford, with Bryn Mawr as a median.

This table of marriage rates and birth rates gives the figures from approximately the beginning of each college down to 1901. In the case of Bryn Mawr and of Holyoke, however, the founding of them was at a much later date than that of the others. (Holyoke existed as a Seminary only, prior to 1890.) Since therefore neither of these colleges has the body of older graduates that the other colleges have, we should expect to find marriage and birth rates correspondingly lower. Since this is not the case in the birth rates at Bryn Mawr, we may assume a somewhat higher birth rate there in proportion to the other colleges, than is shown by the figures. Since the figures for the 8 colleges whose combined records appear show a slightly lower birth rate than the median taken from the entire table, we may assume a slightly lower rate for the colleges included in it, Wells, Radcliffe, Northwestern, whose separate figures were not obtainable, than for the colleges for which separate figures were secured.

A comparison of the absolute number of children in each case with the number of graduates in the 4 colleges from which these figures were obtainable, shows the following results: Smith 59.4, Vassar 83.9, Bryn Mawr 82.3, and Holyoke 76.3 children per 100 graduates. This rate apparently falls far short of properly maintaining the population. The small percentage of marriages among graduates, coupled with the low birth rate spells population decline. If, however, the matter is viewed from the standpoint of the married college graduate, the story is much better. A comparison of the number of married graduates with the number of children gives

the following result per one hundred married graduates: Smith 126.4, Vassar 164.3, Bryn Mawr 172.4, and Holyoke 182.3 children. These figures average about 1.6 children per married graduate.

TABLE VIII.

MARRIAGE AND BIRTH RATES OF CERTAIN COLLEGES BY DECADES.

Classes.	College.	Number of Graduates.	Married		Total Number of Children.	Number of Children per 100 Graduates.	Number of Children per 100 Married Graduates.
			Number	Per Cent.			
1870 to 1879	Vassar	383	208	53	422	110 1	207 6
	Bryn Mawr						
	Wellesley						
1880 to 1889	Vassar	376	208	55 3	348	92 5	167 3
	Bryn Mawr						
	Wellesley	518	257	49—	427	82.3	166 1
1890 to 1899	Vassar	791	376	47 5	553	69 9	147 0
	Bryn Mawr	294	123	41 8	211	71 7	171 5
	Wellesley	1,201	523	43 5	776	64 6	110 1
	Holyoke	377	158	41 9	288	76 3	182 3
1900 to 1909	Vassar	1,874	500	26 6	344	18 3	68 8
	Bryn Mawr	688	244	35 4	189	27 6	77.4
	Wellesley						
	Holyoke.........	1,206	285	23 6	260	21 5	91 2

It is apparent that not even in the decade 1870–79 was the birth rate high enough to maintain the population, when both the unmarried graduates and the husbands of the married graduates are taken into account. The rate in the next two decades declines for Vassar and Smith to 92.5 and 82.4 children respectively per 100 graduates. In the following decade these two colleges decline to 69.9 and 64.6 respectively, but Bryn Mawr and Holyoke here began their existence, and their rates for the classes of this decade are slightly higher than the two others. In the decade 1900–1909 the rate is very low owing to recent graduation, and the figures are not worth consideration.

Only 2 colleges (Vassar and Bryn Mawr) give any detailed information regarding the size of families. Of these colleges, Vassar alone has been in existence long enough to show any marked change in family size.

TABLE IX.

SIZE OF FAMILIES OF WOMEN COLLEGE GRADUATES.

College and Period.	Total Married Graduates.	Number of Married Graduates Having Each of the Following Number of Children.								Total Children.
		One.	Two.	Three.	Four.	Five.	Six.	Seven.	Eight.	
Vassar:										
1867–1901	961	201	209	143	61	29	11	6	2	289
1867–1910	1,323	316	244	146	61	29	11	6	2	503
Bryn Mawr:										
1890–1912	380	86	84	47	14	11	3			135
Vassar:										
1867–1876	181	24	26	35	20	14	5	2	1	
1877–1886	207	33	40	33	17	7	5	8	1	
1887–1896	273	57	74	44	17	8				
1897–1901	276	87	69	31	17					

It will here be seen in the case of Vassar that the size of families has been smaller since 1901 than previous to that date. No Vassar graduate since that date has had a family of over three children, and only three have had a family of three. Vassar graduates since 1890 have had no families of six, six families of five, and eighteen families of four children each. The figures of Bryn Mawr, therefore, while they seem lower on the table, are really not so for the same period of years.

The last table which seems of value is published in the Bryn Mawr catalogue for 1913, page 298.

TABLE X.

NUMBER OF MARRIAGES AMONG BRYN MAWR GRADUATES AND NUMBER OF CHILDREN BORN, BY YEAR OF MARRIAGES, 1890–1912.

Year of Marriage.	Duration of Marriage in Years.	Number of Graduates Married Each Year.	Number of Children.			Average per Marriage.
			Boys.	Girls.	Total.	
1890	22–23	1	1	2	3	8.0
1891	21–22	4	5	5	10	2.5
1892	20–21	2	0	3	3	1.5
1893	19–20	3	6	8	14	4.7
1894	18–19	5	5	4	9	1.8
1895	17–18	9	7	9	16	1.8
1896	16–17	3	6	2	8	2.7
1897	15–16	4	7	3	10	2.5
1898	14–15	5	12	9	21	4.2
1899	13–14	14	6	10	16	1.1
1900	12–13	12	14	14	28	2.3
1901	11–12	13	18	14	32	2.5
1902	10–11	10	13	8	21	2.1
1903	9–10	15	11	15	26	1.7
1904	8–9	23	31	32	63	2.7
1905	7–8	29	29	24	53	1.8
1906	6–7	36	23	34	57	1.6
1907	5–6	29	18	17	35	1.2
1908	4–5	30	22	11	33	1.1
1909	3–4	28	16	18	34	1.2
1910	2–3	31	3	15	18	0.6
1911	1–2	34	8	6	14	0.4
1912	Under 1	52	0	0	0	0.0
1890 to 1912		392	261	263	524	1.3

We here have an opportunity for the first time to compare the number of children with the duration of the marriage. The average number of children per family of ten or more years' duration is 2.7, showing a rate slightly higher than that necessary to maintain a static population, provided no deaths occur. Holyoke gives a similar figure here, showing an average of 2.43 children born to each of 439 married graduates of the decade 1890–99.

Available figures dealing with the fecundity of college women are few in number and narrow in scope—the same data are not given in every case, and comparison is difficult. Figures for the past deal with the number of graduates having children, rather than the number of children, hence the difficulty of showing accurate details of the number of children per marriage. Since in each case, of the five colleges furnishing the best data, Bryn Mawr was nearest to the median, her figures can reasonably be assumed to represent the approximate situation in those colleges not giving complete data (Smith and

Rockford). Since further, the Bryn Mawr table for duration of marriage shows that all marriages of over ten years' duration average 2.7 children, the following conclusion may be drawn:

1. Where all college graduates are included up to date the number of children per graduate would be slightly above three fourths, the number per married graduate would be approximately one and one half.

2. Where only those graduates who have been graduated a sufficient number of years to allow for marriage and all probable family increase, are considered, the rate would be approximately 2 to 2½ children per family.

So much for the available figures for college graduates. Of all possible comparisons, the fairest, in fact the only fair comparison, is with the sisters, cousins, and friends of these college women, who did not themselves attend college. Here social and economic considerations would have equal weight, and any difference in rate would most probably be traceable to the college training.

Mary Roberts Smith in an article on the Statistics of College and Non-College Women (1900)* has made such a study and obtained from it valuable conclusions. Schedules were sent by her to 343 college mothers and 313 non-college mothers who were their sisters, cousins, and friends. She summarizes her conclusions as follows:

1. The marriage of college women was postponed two years as compared with that of non-college women (26.3 *vs.* 24.3 years).

2. The age of marriage for both classes has been growing in the last thirty years,—a larger per cent. of the non-college mothers marrying before the age of 21; a larger per cent. of the college mothers marrying after 34.

3. The non-college women have been married an average of 2 years longer than the college women and have borne a slightly larger number of children, but the college women have borne the larger number of children per year of married life.

* Quarterly Publications of the American Statistical Association, No. 49–50, Volume VII, March–June, 1900, p. 1.

Significant comparison may be made between the men. If we compare the fecundity of Yale graduates to the fecundity of women college graduates, we get the following results.*

TABLE XI.

A COMPARISON OF THE BIRTH RATES OF YALE AND VASSAR GRADUATES, CLASSES OF 1867 TO 1886 INCLUSIVE. NUMBER OF CHILDREN PER MARRIED GRADUATE.

Yale:	
1867–1886	2.02
Vassar:	
1867–1886	1.09

Another interesting comparison might be made between women college graduates and women graduates of normal and high schools, who did not go to college, but here again it is rendered impossible by the fragmentary character of the material. Authoritative data was secured for only two classes and conclusions from them would carry little weight.

A comparison of college birth rates with those of the population at large are of little value because of the differences in age, sex, social and economic position. Moreover, statistics of the population at large in the United States have never been compiled. In the registration area, where some work has been done, imperfect registration of birth renders the figures of somewhat doubtful value.

One study, however, has been made which gives us comparable figures from the population at large. I refer to an article by Dr. Joseph A. Hill in the QUARTERLY PUBLICATIONS OF THE AMERICAN STATISTICAL ASSOCIATION.† Dr. Hill's study included in all 185,788 women, 78,432 of whom had been married ten to twenty years. These 78,432 were divided into four classifications: (1) white native parentage, (2) white foreign parentage (first generation), (3) (second generation), (4), negro. The areas covered were the state of Rhode Island, the city of Cleveland and 48 mainly rural counties in Ohio, Minneapolis, and 21 mainly rural counties in Minnesota. The native white of native parents are of course the only ones that can fairly be compared with our college women. For them the figures were as follows:

* Statistics of Yale Graduates, Yale Review, 1908–09, p. 337.

† Quarterly Publications of the American Statistical Association, Vol. XIII, Dec. 1913, p. 583.

TABLE XII.

BIRTH RATE OF NATIVE-BORN WHITE AMERICAN WOMEN UNDER 45 YEARS OF AGE, MARRIED 10-20 YEARS.

Total Number.	Bearing No Children.		Total Number of Children.	Average per Married Woman.	Per Cent. Bearing.		
	Number.	Per Cent.			1 or 2.	3, 4, or 5.	6 or More Children.
15,953	2,097	13.1	42,933	2.7	39.8	37.2	9.9

The interesting fact here is that Dr. Hill's average number of children per married woman, 2.7, is identical with the 2.7 children which each Bryn Mawr marriage of over ten years duration averages. Here, at least, we find two groups of women, college, and selected from the population at large, identical as to age, race, and duration of marriage, who average the same number of children per marriage.

In conclusion we may say, first, that the birth rate of college women is ascertainable; second, that, in so far as it can be compared to that of the sisters, cousins, and friends of college women, it is probably very little lower, or about the same, *i. e.*, the non-college woman has more children, but the college woman bears more per year of married life; third, if we compare it with that of men college graduates, we find only a lower rate for the women; fourth, in comparing it with the only definite study so far discovered, of women from the population at large, of similar race, of child-bearing age, married ten to twenty years, we find almost completely identical figures. Obviously none of these comparisons are of great value. The numbers included are in most cases too small or the ground covered too limited to enable us to give the results any widespread application.

The purpose of this study, as stated in the introduction, was the answering of two definite questions: First, is the higher education of women absolutely and relatively increasing in this country? Second, has this increase, if there is any, an appreciable effect upon fecundity?

The first of these questions must be answered definitely in the affirmative. A careful investigation of the figures at hand shows not only a larger absolute number of girls than of boys

in the high schools of the United States, but a greater ratio of increase in college attendance for girls than for boys, and a steady increase in the proportion of women students to the entire body of college students.

The answer to the second question—Has this increase in the higher education of women any effect upon fecundity—is not so satisfactory. It has been found (1) that the proportion of women college graduates who marry is approximately one half (slightly over one half in most cases); (2) that the proportion of men college graduates who marry is somewhat higher; (3) that, comparing college women with the census figures of population at large, the marriage rate among non-college women is considerably higher (59 per cent.) than among college women; (4) that the higher marriage rate of men and non-college women (where it is higher) may quite conceivably be due to causes other than that of education.

The figures and conclusions obtained are, at best, inadequate. Obviously they fall far short of showing any appreciable effect of the higher education of women upon fecundity. The college statistics are accurate and reliable as far as they go, but there are too few colleges which keep any records of fecundity, and the greater part of the figures obtainable are too recent to be fairly representative of college fecundity. High and normal school statistics on the subject of fecundity are practically non-existent, and present a field of work which would adequately repay careful investigation. The figures do prove conclusively the impossibility of justifying any statement that the higher education of women does or does not lower fecundity.

As far as any positive conclusion is concerned, the figures only show the existence of two separate phenomena of continually increasing importance, which might, were all the facts of the case revealed, show a close inter-relation. Obviously the importance of investigating the facts and obtaining all possible information and statistics cannot be overestimated. The entire trend of our higher education of women should be, and I confidently believe will be determined in large measure by its effect upon fecundity.

REVIEWS AND NOTES.

Dr. Georg von Mayr, the distinguished German statistician, who has been chosen for the current year as rector of the University at Munich, devoted his rector's address* to the position of the political sciences in university education. Speaking of statistics, he said in substance:

Statistical data have multiplied exceedingly and inferences regarding the conditions and changes of man's social life are steadily accumulating. But by the irony of fate, along with these conditions, strange destructive tendencies are at work. The attempt is made to demolish statistics as a science and relegate the statistician to the position of a Helot allowed only to gather materials for the use of other sciences. Modern epistemologists have sought, with revolutionary theories, to clear our science out of the way, but in the end, they cannot escape bringing it back under another title, as a social science of masses which can be counted and measured; only they refuse it the name of statistics. Furthermore, within our own camp, we have enemies in the shape of some mathematical statisticians who would limit statistics to certain regularities in social or other masses which can be expressed in definite formulas, and thus they would leave our science stunted and barren.

At present, we are without a clear and coherent conception of the political sciences but such a conception is slowly taking shape. We may distinguish the original or literal sense of political science, of which the state is the center, and the later, or derivative, sense, in which statistics, sociology, and economics stand beside politics, or the science of the state, as coördinate branches of political science or social science. Statistics, as the science of social mass phenomena, so far as they can be counted or measured, is bound to take an important place in this new development of the social sciences.

W. F. W.

* Die Staatswissenschaften und ihr Standort im Universitätsunterricht, München, 1913, pp. 27.

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THE OCCUPATION HAZARD OF LOCOMOTIVE FIREMEN.

BY HENRY J. HARRIS.

The occupation hazard of any employment is now a matter in which the general public is taking an ever-increasing interest. The recent wave of accident insurance legislation in the United States has called attention to the high accident rate in many of our industries and occupations; in the recent arbitration of a wage controversy between locomotive engineers and their employers, emphasis was placed on the fact that the trade life of the locomotive engineer was but from ten to twelve years; the presidents of two prominent trade unions not long ago urged that the protection of such organizations was necessary to prevent men from being thrown on the scrap heap at an early age under present-day conditions. We know so little, however, about the hazard of occupations and the length of working life at the present time that any attempt to measure the loss of a group of employees caused by accident, sickness, and general loss of working power from conditions peculiar to an occupation is usually blocked by the absence of any accurate information on these subjects.

For a few occupations there does exist a certain amount of scattered information which, when brought together, throws considerable light on this question. Among such, the occupations of locomotive firemen and locomotive engineers have frequently been studied from various points of view. By comparing the material collected from time to time by different agencies, one can obtain an estimate of the special risks and general hazard of these occupations which is sufficiently accurate to form the basis for some general conclusions in regard to the occupational hazard of the employment. The

study of the occupation of locomotive firemen is rendered difficult by the fact that it is as a rule a preliminary occupation, because most firemen are in the course of time promoted to the position of engineer. Partly on this account, the statistics of the Interstate Commerce Commission usually combine all men employed on trains in the reports of accidents, while in the federal mortality returns, all steam railroad employees are reported in one total. For this reason, it has been necessary to use the statistical data furnished by special studies and by sources less comprehensive than the federal statistics, or the returns of the Registrar-General of Great Britain.

Extent of the Occupation.

The occupation returns of the census of 1910 present the class of locomotive firemen separately for the first time in the history of the census. The following table shows the figures for this occupation together with those for the locomotive engineers:

TABLE I.

NUMBER OF LOCOMOTIVE FIREMEN AND ENGINEERS IN THE CENSUS OF 1910, BY AGE GROUPS AND PARENTAGE.

(Source: Thirteenth Census of the United States, 1910, Vol. IV., Population-Occupation Statistics, pp. 416, 417.)

Age Groups and Parentage.	Locomotive Firemen.	Locomotive Engineers.
Total	76,381	96,229
Age groups:		
14 to 15 years	19	....
16 to 20 years	6,627	891
21 to 44 years (including age unknown)	66,257	66,605
45 years and over	3,478	28,733
Native white:		
Native parentage	49,674	62,672
Foreign or mixed parentage	15,108	23,062
Foreign-born white	6,395	10,133
Negro	5,188	355
Indian, Chinese, Japanese, and all others	16	7

The number of locomotive firemen in the United States as given above is 76,381. The report contains the warning that the enumerators did not always separate the stationary firemen and stationary engineers from those employed on locomotives so that the above total may be slightly in excess of the actual number, which may be assumed to be about 75,000 men. The number of members of the Brotherhood of Locomotive

Firemen and Enginemen on December 31, 1910, was 73,469; in 1911 it was 79,942 and in 1912 it was 85,292.* As the organization includes a number of locomotive engineers, the figures are in substantial agreement with the census returns.

The general characteristics of the firemen's group are that it consists entirely of males, that it is a young men's occupation (the number over 44 years of age is only about 3,500 out of the total of 75,000), that the great majority (two thirds) are descended from American-born parents and that only about 6,000 of the 75,000 were foreign born.

The general characteristics of the firemen group, therefore, are such as would produce a favorable death-rate. This tendency is enhanced by the fact that applicants for employment as firemen are usually subjected to a careful medical examination by the surgeons of the railroad companies† and all applicants with physical defects or below a high standard of physique are rejected.

The Mortality of Locomotive Firemen.

One of the most definite indications of the general hazard of an occupation consists of the death-rate of those engaged in that occupation. For locomotive firemen we have several computations of the death-rate. These computations were made by life insurance companies or by life insurance actuaries, and the rates compiled are based on their experience in insuring the lives of men engaged in this occupation. It is well to call attention to the fact that the persons insured are carefully selected by the insurance companies so that the group whose lives furnished the basis for these rates is composed of men of more than average prudence, selected by prudent insurance companies and engaged in an occupation in which only persons of excellent physique are employed. The death-rate for the occupation of locomotive firemen ought therefore to be a favorable one.

The Medico-Actuarial Investigation. The most recent study of the mortality of hazardous occupations in America is that entitled "Medico-Actuarial Mortality Investigation." It

* Eastern Concerted Wage Movement, p. 276.

† For a typical form used in such examinations, see the New York Central Railroad blank reprinted in Eastern Concerted Wage Movement, p. 391.

was made by the Association of Life Insurance Medical Directors and the Actuarial Society of America and included the experience of the leading American life insurance companies. Only those occupations were included for which the number of deaths was large enough to form the basis of a rate. The following table gives a summary of the data for all the railroad occupations included in this investigation:

TABLE II.

ACTUAL AND EXPECTED NUMBER OF DEATHS OF LOCOMOTIVE FIREMEN AND OTHER RAILWAY EMPLOYEES ACCORDING TO THE MEDICO-ACTUARIAL INVESTIGATION.

(Source: Medico-Actuarial Mortality Investigation, 1913, Vol. III, pp. 133–141.)

Ages at Entry	Railway Locomotive Firemen.		Railway Locomotive Engineers.		Railway Check Clerks, Freight Inspectors, Car Inspectors, Car Sealers, Yard Clerks and Yard Masters.		Railway Passenger Trainmen (not Conductors).		Railway Track Supervisors and Foremen. Section Foremen.	
	Actual Deaths.	Expected Deaths.	Actual Deaths.	Expected Deaths.	Actual Deaths.	Expected Deaths.	Actual Deaths.	Expected Deaths.	Actual Deaths.	Expected Deaths.
15–29	141	70.23	88	46.00	58	43.87	40	24.56	74	64.85
30–39	42	24.96	243	150.74	71	52.46	24	18.04	170	129.15
40–49	7	5.67	147	94.08	62	34.03	7	8.03	111	86.39
50–59	3	.93	62	42.64	29	23.08	4	4.09	56	40.99
60 and over	....	.....	3	4.92	1	3.48	1	.80	10	11.70
Total	193	101.84	541	337.38	221	156.92	76	55.52	421	333.07

RATIO OF ACTUAL TO EXPECTED DEATHS.

Ages at Entry	Railway Locomotive Firemen.		Railway Locomotive Engineers.		Railway Check Clerks, etc.		Railway Passenger Trainmen.		Railway Track Supervisors, etc.	
15–29	201	100.0	191	100.0	132	100.0	163	100.0	114	100.0
30–39	168	100.0	161	100.0	135	100.0	133	100.0	132	100.0
40–49	123	100.0	156	100.0	182	100.0	87	100.0	129	100.0
50–59	323	100.0	146	100.0	126	100.0	98	100.0	137	100.0
60 and over	....	100.0	61	100.0	29	100.0	125	100.0	85	100.0
Total	190	100.0	160	100.0	141	100.0	137	100.0	126	100.0

It should be stated that the "expected deaths" in the preceding table are those calculated by the M. A. Table, which will be found in the reports in Vol. I, page 89 and Vol. III, page 27.

The committee in charge of the investigation state that "generally the excess of the mortality ratio over 100 per cent. indicates the extent of the extra mortality due to the particular occupation in question" (Vol. III, page 6). The hazard of the firemen's occupation is, by the preceding table, shown to be

about 90 per cent. above the average of the persons accepted by the larger American life insurance companies. Of all the railway occupations included in the investigation, the firemen show the highest risk, though it must be remembered that certain occupations, *e. g.*, brakemen, undoubtedly have a higher risk and are accepted in such small numbers that the computation of a rate was not feasible. The group of locomotive engineers shows a distinctly lower hazard than the firemen; the difference, it will be noted, occurs in the younger age groups of the firemen. At the ages of entry, 15 to 29, the ratio for the engineers is 191 per cent. and for the firemen 201 per cent., and at ages 30 to 39 it is 161 per cent. and 168 per cent. respectively. Of the total policies 79 per cent. were issued to the firemen at ages 15 to 29, and 19 per cent. at ages 30 to 39, against 24 per cent. and 52 per cent., respectively, to the engineers.

The Specialized Mortality Investigation. An earlier investigation of the mortality of hazardous occupations, generally referred to as the "Specialized Mortality Investigation" which was conducted by the Actuarial Society of America, shows the same general tendencies among the railway employees.* Because of the omission of certain types of risks, this study does not give as accurate results as the Medico-Actuarial Investigation, but the data are of value as showing the relative hazard of the occupations included, which comprise some not given in the later investigation. The following table summarizes the returns for all the occupations in this study connected with railroading:

* *Experience of thirty-four life companies upon ninety-eight special classes of risk,* Compiled and published by the Actuarial Society of America, New York, 1903.

TABLE III.

ACTUAL AND EXPECTED NUMBER OF DEATHS OF LOCOMOTIVE FIREMEN AND OTHER RAI WAY EMPLOYEES AS COMPUTED BY THE ACTUARIAL SOCIETY OF AMERICA.

(Source: Experience of thirty-four life companies upon ninety-eight special classes of risk, p. 473.)

Ages at Entry.	Railway Locomotive Firemen.		Railway Locomotive Engineers.		Railway Express Messengers.		Railway Mail Clerks.		Railway Passenger Trainmen.		Railway Passenger Conduct	
	Actual Deaths.	Expected Deaths.	Actual Deaths.	Expected Deaths.	Actual Deaths.	Expected Deaths.	Actual Deaths.	Expected Deaths.	Actual Deaths.	Expected Deaths.	Actual Deaths.	Expe Dea
15–28	37	21.2	29	22.9	13	16 5	24	28.9	9	5 5	33	30
29–42	20	14 0	155	108 7	13	17 8	31	37.3	12	8.4	122	126.
43–56	3	2.7	55	37.3	7	3 9	9	13 0	3	2 2	49	35
57–70	1	.2	1	4 3	1	1	1	1 5	....	.3	3	4.
15–70	61	38.1	220	173 2	34	38 3	65	80.7	24	16.4	207	206.

RATIO OF ACTUAL TO EXPECTED DEATHS.

Ages at Entry.												
15–28	175.9	100.0	126 6	100.0	78.8	100 0	83 0	100.0	163 6	100 0	109 3	100
29–42	142 8	100 0	142 2	100 0	73 0	100 0	83.1	100.0	142 9	100 0	89 5	100
43–56	111 1	100 0	147.5	100 0	179.5	100 0	69 2	100 0	136 4	100.0	137 3	100
57–70	500 0	100 0	23.2	100.0	100.0	100 0	66 7	100 0	....	100.0	65 2	100
15–70	160 1	100 0	127 0	100.0	88 0	100.0	80.5	100.0	146.3	100.0	100.1	100

The expected deaths in the above table are practically identical with Farr's Healthy English Male Table; the revised form of this table (as used in this study) will be found on page XIV of the report. The highest mortality is shown by the firemen with a ratio of actual to expected deaths of 160 per cent.; the passenger trainmen with 146 per cent. come next, while the locomotive engineers with a ratio of 127 per cent. rank third.

Experience of the New York Life Insurance Company. Similar results are shown by the study of Mr. Arthur Hunter, the actuary of the New York Life Insurance Company, based on the experience of that company.* In that company the ratio of actual to expected deaths for locomotive firemen was 174 per cent., for locomotive engineers 145 per cent. Mr. Hunter remarks "the mortality among those insured as firemen appears to be much higher than among those insured as engineers, although it is hard to find an entirely satisfactory reason for such a considerable difference."

* Transactions of the Actuarial Society of America, May, 1907, Vol. 10, No. 37.

Change of Occupation. In all of these actuarial studies, where the occupation is given as fireman, it means that such was the occupation when the policy was taken out, and this designation is retained in computing the death-rate even when the insured person was actually employed as an engineer at the time of his death. This fact, however, does not detract from the value of the tables as much as it might at first appear, because of the very high death-rates in the first few years after the insurance is taken out. The following table emphasizes this point:

TABLE IV.

ACTUAL AND EXPECTED DEATHS OF LOCOMOTIVE FIREMEN ACCORDING TO THE MEDICO-ACTUARIAL INVESTIGATION.

(Source: Medico-Actuarial Mortality Investigation, Vol. III, p. 137.)

Insurance Years.	Age at Entry 15–29.				Age at Entry 30–39.			
	Exposed to Risk.	Actual Deaths.	Expected Deaths.	Ratio per cent.	Exposed to Risk.	Actual Deaths.	Expected Deaths.	Ratio per cent.
1-5...	11,759	104	48.82	213	3,158	24	14.67	164
6-7...	2,028	14	9.92	141	661	6	3.71	162
8-10..	1,546	14	7.72	181	653	6	3.99	150
11-15.	643	9	3.42	263	334	6	2.44	246
16-24.	67	....	.40	....	16	....	.15	....
1-24..	16,043	141	70.28	201	4,822	42	24.96	168
	40–49.				50–59.			
1-5...	376	2	2.68	75	40	1	61	164
6-7...	86	3	.86	349	7	1	16	625
8-10..	77	2	.94	213	5	1	.16	625
11-15.	48	....	.82	....	....	....	....	....
16-24.	13	....	.37	....	....	....	....	....
1-24..	600	7	5.67	123	52	3	.93	323
	60 and Over.				All Ages at Entry.			
1-5...	....	....	....	....	15,383	131	66.78	196
6-7...	....	....	....	....	2,782	24	14.65	164
8-10..	....	....	....	....	2,281	23	12.81	180
11-15.	....	....	....	....	1,025	15	6.68	225
16-24.	....	....	....	....	96	....	.92	....
1-24..	....	....	....	....	21,517	193	101.84	190

The preceding table shows that the firemen's mortality rate is based on 193 deaths and that of these deaths, 131 occurred within five years after the policy was issued; the detailed tables of the investigation also show that 107 of the 193 deaths occurred in the first three years after the issue of the policy. It is safe to claim, therefore, that the rates of the various

actuarial studies are sufficiently accurate for present purposes as showing the high mortality of the occupation.

Mortality of Brotherhood of Locomotive Firemen. The death-rate of the membership of the Brotherhood of Locomotive Firemen and Enginemen also illustrates the hazard of the occupation, though as the figures include both firemen and engineers, they do not show a definite rate for firemen. The following table was prepared by the officers of the insurance organization of the Brotherhood:

TABLE V.

DEATHS AMONG THE MEMBERS OF THE BROTHERHOOD OF LOCOMOTIVE FIREMEN AND ENGINEMEN, 1882-1912.

(Source: Eastern Concerted Wage Movement, page [illegible].)

Years.	Number of Members.	Number of Deaths.	Deaths per 1000 Members.
1882	5,125	12	2.341
1883	7,888	44	5.578
1884	12,246	54	4.409
1885	14,849	74	4.973
1886	16,196	98	6.051
1887	17,047	81	4.751
1888	18,278	110	6.018
1889	17,087	127	7.432
1890	18,657	159	8.468
1891	22,460	190	8.459
1892	25,967	190	7.317
1893	28,681	226	7.878
1894	26,508	200	7.545
1895	21,408	129	6.026
1896	22,461	160	7.123
1897	24,251	145	5.979
1898	27,039	201	7.433
1899	30,748	220	7.155
1900	36,084	265	7.344
1901	39,072	300	7.678
1902	43,376	354	8.161
1903	48,568	647	13.321
1904	54,434	453	8.322
1905	55,287	496	8.971
1906	58,849	461	7.833
1907	62,916	581	9.234
1908	66,408	437	6.579
1909	66,315	412	6.208
1910	73,469	520	7.077
1911	79,942	523	6.542
1912	85,292	561	6.577

Estimate of the Occupation Hazard by Life Insurance Practice. The attitude of the larger life insurance companies towards the occupation of locomotive firemen has been determined by the facts just presented. Some of the companies refuse entirely to accept firemen while others accept them under certain restrictions. The New York Life Insurance Company, for

instance, in its circular of instructions to agents (Form 1519, issued May, 1912), explains that insurance will be accepted for certain hazardous occupations, but subject to the restriction that the applicant for insurance must pay the premiums for a higher age, and if the occupation is unusually hazardous, may be given only the endowment form of insurance. The circular (page 11) specifies that passenger conductors, express messengers, telegraphers, and train despatchers may be accepted at their actual age and may be given the regular life policies. Locomotive engineers must have 8 years added to their actual age and may receive no cheaper policy than a 20-year endowment. Locomotive firemen, however, must have 12 years added to their actual age and may receive no cheaper policy than a 20-year endowment.

Comparison with other Occupations. Of the occupations included in the medico-actuarial investigation, the mortality rate of firemen is exceeded only by certain occupations connected with mining and stonecutting; in addition, it is the highest of any of the railway occupations given in the report. To show the relation of the firemen's death-rate to those of other occupations, the following table presents, with two exceptions, all of the occupations included in the medico-actuarial investigation; the exceptions are, first, the numerous occupations connected with the liquor traffic, omitted as not being of interest in the present connection, and second, those occupations whose excess over the normal death-rate was less than 25 per cent.

* The rules of a large number of American life companies on this point are cited in Eastern Concerted Wage Movement, pp. 338–

TABLE VI.

MORTALITY RATES OF HAZARDOUS OCCUPATIONS.

(Source: Medico-actuarial Mortality Investigation, Vol. 3, pp. 28-31.)

Group Number.	Occupation.	Actual Deaths.	Expected Deaths.	Ratio of Actual to Expected Deaths.
44	Underground mines other than coal mines working miners	642	282.86	226
188	Stone-cutters, journeymen	76	35.45	214
42	Surface mines—placer, drift, hydraulic, etc. working miners	70	33.72	208
45	Coal mines: working coal miners (anthracite)	66	34.55	191
58	Railways: locomotive firemen, excluding issues prior to 1890	193	101.84	190
53	Potteries: employees molding potter's clay (excluding foremen and superintendents)	28	16.45	170
43	Underground mines other than coal mines: foremen and bosses	54	32.12	168
64	Structural iron works (including house-smiths and bridge-builders)	74	43.96	168
41	Surface mines—placer, drift, hydraulic, etc.: foremen and bosses	23	14.38	160
57	Railways: locomotive engineers, excluding issues prior to 1890	541	337.38	160
47	Navy—commissioned officers (excluding chaplains, physicians, surgeons and paymasters)	149	97.79	152
15	Fire departments, city: firemen, laddermen, pipemen and hosemen	155	104.55	148
19	Glass industry: bevelers, grinders, engravers and cutters of glass, excluding foremen and superintendents	77	52.60	146
69	Theaters: actors (including vaudeville performers, but excluding acrobats and circus performers)	87	60.15	145
11	Electric light, heat and power systems: linemen (pole climbers) and arc light trimmers	71	50.06	142
59	Railways: check clerks, freight inspectors, car inspectors, car sealers, yard clerks and yard masters	221	156.93	141
50	Police and prisons: city policemen	526	377.67	139
190	Steam vessels: officers and engineers in coastwise trade, excluding those traveling to the tropics	34	24.60	138
56	Railways: passenger trainmen (not conductors) excluding issues prior to 1890	76	55.52	137
68	Theaters: proprietors, managers and treasurers of theaters, music halls and vaudeville houses	153	112.65	136
39	Underground mines—supervision: engineers, superintendents and managers occasionally going under ground (excluding coal mines)	268	197.98	135
17	Hatters, journeymen, excluding straw-hatters	84	62.74	134
51	Police and prisons: marshals, sheriffs and constables (excluding chief sheriffs not exposed to hazard from occupation)	475	355.07	134
46	Coal mines: working coal miners (bituminous)	45	34.22	132
1	Army-commissioned officers, excluding chaplains, physicians, surgeons and paymasters	324	247.32	131
161	Motormen on street electric lines	28	21.41	131
123	Domestic servants (women)	183	143.18	127
60	Railways: track supervisors and foremen and section foremen	421	333.07	126
154	Livery stables—proprietors	274	216.84	126

The occupations which are conspicuous for their high death-rates are: first, the miners and workers in stone and clay; second, the locomotive firemen; third, the structural iron

workers; and fourth, the locomotive engineers. The occupations connected with the liquor business rank with these groups. The risks connected with mining operations are well known and are so serious as to have a special government bureau devoted to their amelioration. The locomotive firemen may be said to rank next to the mining occupations.

Accidents to Locomotive Firemen.

FATAL ACCIDENTS.

Returns of the Interstate Commerce Commission. The accident reports of the Interstate Commerce Commission contain the most accurate returns of accidents to railway employees. Since the revised form of table was adopted in 1910 the fatal accident rates to employees engaged in the movement of trains has been as follows:

TABLE VII.

FATAL ACCIDENTS TO RAILROAD TRAINMEN* 1911-1913.

NUMBER OF TRAINMEN IN SERVICE ON JUNE 30, 1911, 1912, AND 1913 AND NUMBER EMPLOYED FOR ONE KILLED.

(Interstate Commerce Commission Accident Bulletins 40, 44, and 48.)

Year.	Number Employed.	Number Killed.	Number Employed for one Killed.	Deaths per 1,000 Employees.†
1910-1911	235,841	1,218	194	5.16
1911-1912	245,653	1,182	208	4.81
1912-1913	251,111	1,173	231	4.67

* "Trainmen" include enginemen, firemen, motormen, conductors, brakemen, rear flagmen, train baggagemen and train porters on trains.
† Computed.

The returns of the Commission do not give the data for locomotive firemen separately. The preceding table is given to show the high death-rate from accidents of the general class to which the firemen belong.

Accident Rates Compiled by the United States Employers' Liability Commission. The report of the United States Commission on Employers' Liability and Workmen's Compensation contains a study of accidents to railway employees covering the three years, 1908 to 1910; the returns were secured by the voluntary coöperation of the railroads, but include only selected roads where it is probable that the accident rate was lower than the average for the whole country. The following

table shows the results of this study for the two occupations of locomotive firemen and engineers:

TABLE VIII.

FATAL ACCIDENTS TO LOCOMOTIVE FIREMEN AND ENGINEERS, 1908-1910, AS REPORTED BY THE UNITED STATES EMPLOYERS' LIABILITY AND WORKMEN'S COMPENSATION COMMISSION.

(Source: Report of the Employers' Liability and Workmen's Compensation Commission, Vol. 1, pp. 147-148.)

Occupation.	Number of Employees.	Number of Deaths.	Deaths per 1,000 Employees.
Locomotive Firemen.			
Passenger	23,652	97	4.10
Freight	61,601	291	4.72
Yard	27,837	53	1.90
Mixed	4,520	20	4.42
Total	117,610	461	3.92
Locomotive Engineers.			
Passenger	23,425	130	5.55
Freight	55,717	231	4.15
Yard	25,876	43	1.66
Mixed	4,341	18	4.15
Total	109,359	422	3.86

The greater risk to the firemen is connected with freight traffic while to the engineer the higher risk comes from passenger traffic.

Fatal Accidents in the Brotherhood of Locomotive Firemen. The membership statement of the Brotherhood of Locomotive Firemen and Enginemen does not report the number of firemen, enginemen, hostlers, etc., separately. For the total membership, the number of deaths caused by railroad accidents is as follows:

TABLE IX.

DEATHS OF MEMBERS OF THE BROTHERHOOD OF LOCOMOTIVE FIREMEN AND ENGINEMEN, 1904–1912, BY ACCIDENT AND OTHER CAUSES.

(Source: Eastern Concerted Wage Movement, pp. 276, 279.)

Year.	Number of Members.	Number and Cause of Death.			
		Railroad Accidents.	Diseases.	All Other.	Total.
1904	54,434	236	182	35	453
1905	55,287	260	203	33	496
1906	58,849	234	196	31	461
1907	62,916	287	260	34	581
1908	66,408	195	199	42	436
1909	65,315	182	195	34	411
1910	73,469	263	227	29	519
1911	79,942	214	250	58	522
1912	85,292	253	251	54	558

The Medico-Actuarial Investigation. In the medico-actuarial mortality investigation, the death-rate from accident is mentioned in the introductory text of Volume 3, but no tabulation is given. The text of the report shows that the mortality of locomotive firemen from accident is the highest of all the occupations included in the study, being "nine times the normal" (page 19). The next highest rate given is for locomotive engineers with "eight times the normal." In other occupations with high mortality rates, the accident mortality was distinctly lower than that for locomotive firemen; thus, for underground mining, other than coal mines, the fatal accident rate was "seven time the standard"; for anthracite coal miners six times, and for bituminous coal miners more than five times the standard; for structural iron workers, including house-smiths and bridge builders, the death-rate from accident was six times the normal.

Ratings of the International Association of Accident Underwriters. The attitude of the accident insurance companies towards the occupation of locomotive firemen is significant as showing the estimate of students of occupation risks from a commercial standpoint. Instead of using the estimates of individual companies, a general estimate made by the officials of the leading companies through their organization will be sufficient for present purposes. The International Association of Accident Underwriters has issued a "Classification of Occupations for Accident and Health Insur-

ance" (New York, 1912, The Spectator Company), in which the occupations which are accepted for accident insurance are rated in nine classes, the first class being the least dangerous and the ninth class the most dangerous. It should be stated, however, that class 9 includes only non-insurable risks and that class 8, the "Perilous" class, has practically no risks quoted in it except certain rolling mill employees; in fact, the edition of February 1, 1912, has only one reference to class 8. As a matter of fact, therefore, the standard list contains only seven classes of risks. It is significant that this seventh class, officially designated as "Extra Hazardous," is the one in which locomotive firemen are rated. The standard classifications shows, therefore, that the occupation of locomotive firemen is the most hazardous that the companies will accept for accident insurance; anything more dangerous will not be considered. This estimate of the fireman's risk is expressed concretely by the restriction on the amount of insurance allowed and by the premium rate charged. For safe risks, such as that of a general officer of a railroad, $10,000 is the limit of an accident policy; for a locomotive engineer on a northern road, $2,000 is the limit of policy, while for a fireman on a northern road $1,000 is the highest policy permissible. The standard premium rates for a policy providing $1,000 on death or $5 per week during disability also emphasize the greater hazard of the fireman as contrasted with the engineer, as well as with other occupations. The following is the standard accident policy rate for locomotive firemen and engineers on northern roads:

COST OF AN ACCIDENT INSURANCE POLICY FOR LOCOMOTIVE FIREMEN AND ENGINEERS, AS COMPUTED BY THE INTERNATIONAL ASSOCIATION OF ACCIDENT UNDERWRITERS ON FEBRUARY 1, 1912.

Amount Payable for		Annual Premium for	
Death.	Weekly Indemnity.	Firemen.	Engineers.
$1,000 and	$5	$20	$18.00
1,000 and	10	35	31.50

Briefly stated, the fireman must pay $20 for exactly the same policy which the engineer is given for $18. The important fact, however, is that the fireman's occupation is on the margin of insurability; were the risk much greater, the occupation would probably be classed as non-insurable.

Risk of Bodily Injury.

Rate of Injury. It is the experience of the German workman's insurance system that the great number of physical injuries which disable men temporarily cause more economic loss to the group of employees than the deaths. In the case of locomotive firemen, the muscular strain of his occupation, combined with the conditions under which he performs his work, makes this occupation unusually prolific of injuries to various parts of the body. The general group of train employees has the following rate for physical injuries:

TABLE X.

INJURIES TO RAILROAD TRAINMEN,* NUMBER OF TRAINMEN IN SERVICE ON JUNE 30, 1911–1913, AND THE NUMBER EMPLOYED FOR ONE INJURED.

(I. C. C. Accident Bulletins 40, 44, and 48.)

Year.	Number Employed.	Number Injured.	Number Employed for One Injured.	Injuries per 1,000 Employees.†
1910-11	235,841	29,306	8.0	124.3
1911-12	245,653	30,592	8.0	124.5
1912-13	251,111	34,183	7.3	136.1

* "Trainmen" include enginemen, firemen, motormen, conductors, brakemen, rear flagmen, train baggagemen and train porters on trains.

† Computed.

That the risk of injury to which train employees are subjected is extremely high is obvious from the above rate. No separate figures for firemen are given.

The most recent study of bodily injury of railway employees is that of the United States Workmen's Compensation Commission which covered the three years 1908, 1909, and 1910. The information represents the experience of companies operating approximately one half of the total railway mileage of the United States and employing nearly 57 per cent. of all railway employees, excluding officers. The following table shows the data for locomotive firemen and engineers:

TABLE XI.

NUMBER OF INJURIES TO LOCOMOTIVE FIREMEN AND ENGINEERS, 1908-1910.

Source: Report of United States Employers' Liability and Workmen's Compensation Commission, (Vol. 1, p. 148.)

Occupation.	Number of Employees.	Permanent Total Disability.	Permanent Partial Disability.	Temporary Disability (Over 2 Weeks).
		Locomotive Firemen.		
Passenger	23,652	2	30	1,183
Freight	61,601	12	126	4,582
Yard	27,837	4	30	926
Mixed	4,520	1	7	152
Total	117,610	19	193	6,843
		Locomotive Engineers.		
Passenger	23,425	6	24	807
Freight	55,717	10	62	2,664
Yard	25,876	5	32	717
Mixed	4,341	—	3	95
Total	109,359	21	121	4,283

TABLE XII.

RATE OF INJURY TO LOCOMOTIVE FIREMEN AND ENGINEERS, 1908-1910.

Occupation.	Number of Employees.	Rate per 1,000 Employees.		
		Permanent Total Disability.	Permanent Partial Disability.	Temporary Disability (Over 2 Weeks).
		Locomotive Firemen.		
Passenger	23,652	.08	1.27	50.02
Freight	61,601	.19	2.05	74.35
Yard	27,837	.14	1.08	33.27
Mixed	4,520	.22	1.55	33.63
Total	117,610	.16	1.64	58.18
		Locomotive Engineers.		
Passenger	23,425	.26	1.02	34.45
Freight	55,717	.18	1.11	47.81
Yard	25,876	.19	1.24	27.71
Mixed	4,341	—	.69	21.88
Total	109,359	.19	1.11	39.16

The preceding tables show that there is little difference between the firemen and engineers as regards total permanent disablements, but that these cases are relatively few in number. The cases of permanent partial disablement show that the fireman is injured about 50 per cent. more often than the engineer. The cases of temporary disablement also show that the fireman's risk is about 50 per cent. greater than that of the engineer.

Nature of Injuries Sustained. Among railway employees one of the most frequent and serious causes of injury and loss of time is the spraining of joints and muscles. A special study on this subject by Doctor Sneve, Chief Surgeon of the Chicago Great Western Railway, explains that of the accidents reported on this road, sprains and strains of joints and muscles made up 14.45 per cent. of the total. Doctor Sneve says (p. 47) "six years of experience in railroad work leads me to believe that these are precisely the injuries which lay up the employees the greatest length of time."

Doctor Sneve then gives statistics of these injuries reported on his road in the year 1899:*

* American Academy of Railway Surgeons, 1900, pp. 45-46.

TABLE XIII.

SPRAINS AND STRAINS TO MUSCLES AND JOINTS OF EMPLOYEES OF CHICAGO, GREAT WESTERN RAILROAD, 1899.

Character of Injury.	Number.	Cause of Injury.	Number.
Firemen.			
Thumb	2	Falling down	17
Wrist	4	Shaking grates	3
Lumbar	5	Collision	1
Shoulder	4	Muscular exertion	3
Foot and ankle	2		
Knee	2		
Hip and thigh	3		
Forearm	1		
Side	1		
Total	24		24
Brakemen.			
Shoulder	3	Arm twisted	1
Knee	2	Muscular exertion	1
Arm	1	Falling	7
Elbow	1	Turning foot	2
Foot and ankle	5	Lifting	2
Lumbar	2	Collision	1
Total	14		14
Engineers.			
Lumbar	5	Switching	1
Wrists	2	Wreck	1
Leg	1	Falls	5
Elbow	1	Arm caught	1
Thumb	1	Collision	1
		Tank tipped	1
Total	10		10
Section Hands.			
Inguinal region	1	Struck stove	1
Foot and ankle	2	Falls	4
Abdominal muscles	1	Collision	2
Wrists	3	Turned foot	1
Knee	1	Lifting	2
Neck	2		
Total	10		10
Miscellaneous.			
Knee	2	Falls	18
Wrist	6	Muscular exertion	2
Side	2	Scuffling	1
Ankle and foot	13	Caught foot	4
Lumbar	6	Lifting	2
Leg	2	Turning foot	5
Finger	1		
Total	32		32

Doctor Sneve's comment on this table is as follows:

"It will be seen from the table that, as far as occupation is concerned, the greatest number injured, strangely enough, were fireman . . . ."

"We would have expected *a priori* that the number of sprains would have been greatest in the brakemen, who are continually climbing over cars and running backward and forward along the train, but the number of those so injured was only 14. Next were engineers and section hands, . . . and finally all other occupations."

"It appears that engineers hurt their backs, brakemen their ankles, while the firemen sprain backs, wrists, and shoulders indifferently."

To sum up this statement, the testimony of an experienced chief railway surgeon is to the effect that, of the injuries which he believes disable railroad men the greatest length of time, locomotive firemen are injured more than the other railroad employees, and that the nature of their occupation exposes practically all parts of the body to such injury.

Firemen's Injuries Reported in Illinois. The 1910 law of the State of Illinois requires the employer to report to the State bureau of labor all cases of accidents causing disability for more than 30 days. The following table is a list of such injuries which were reported for locomotive firemen to the State bureau during the year 1911:

TABLE XIV.

NON-FATAL ACCIDENTS TO LOCOMOTIVE FIREMEN ON STEAM RAILROADS IN ILLINOIS, 1911.

Name of Railroad.	Date of injury.	Character and Cause of Injury.	Duration of Disability (Days).
C. and A.	Mar. 28	Foot amputated—run over by car	*
C. B. & Q.	Feb. 24	Wrist broken—fell into pit	42
C. B. & Q.	Feb. 26	Arm broken—fell over hydrant	120
C. B & Q.	May 6	Arm broken—fell from engine	90
C. B. & Q.	May 15	Head injured—engine derailed	61
C. B. & Q.	June 9	Ankle injured—falling iron	42
C B. & Q.	June 21	Back injured—collision	40
C. B. & Q.	Sept. 19	Arm broken—fell off engine	33
C. B. & Q.	Oct. 17	Arm broken—engine and car	51
C. B. & Q.	Nov. 13	Arm broken—caught in engine wheel	74
C. & E. Ill.	Feb. 9	Finger injured—shaker bar and can rack	37
C. & E. Ill.	May 12	Body burned—gas explosion	46
C. & E. Ill.	May 27	Leg injured—fell from stool	31
C. & E. Ill.	July 21	Body injured—getting off engine	35
C. & E. Ill.	Oct. 11	Head injured—struck by car	30
C. & E. Ill.	Nov. 15	Leg injured—fell into pit	83
C. & E. Ill.	Nov. 17	Leg burned—hot water	64
C. G. W.	Feb. 2	Head injured—fell off engine	30
C. G. W.	May 22	Wrist broken—fell off engine	90
Ch. Jct.	Aug. 4	Eye destroyed—struck by crane lever	38
Ch. Jct.	Aug. 22	Collar bone broken—fell from engine	50
C & N W.	Jan. 19	Arm broken—flying iron	90
C. & N. W.	May 3	Leg injured—struck tank	70
C. R. I. & P.	Apr. 8	Ankle sprained—getting off engine	47
C. R. I. & P.	June 6	Leg amputated—run over by train	180
C R. I. & P.	Oct. 1	Ankles sprained—fell on coal	120
C R. I. & P.	Dec. 15	Ribs broken—fell into pit	81
E. J & E.	June 9	Knee injured—jumped from engine	75
Ill. Cent.	Feb. 10	Foot broken—jumped from engine	120
Ill. Cent.	Feb. 10	Head injured—engine and car	90
Ill. Cent.	Mar. 16	Hand injured—lever and box	32
Ill. Cent.	May 5	Nose broken—jumped from engine	60
Ill. Cent.	May 8	Ribs broken—fell against door opener	36
Ill. Cent.	May 10	Leg broken—fell from engine	90
Ill. Cent.	May 21	Rib broken—falling bar	45
Ill. Cent.	June 1	Ankle sprained—jumped from engine	40
Ill. Cent.	June 15	Back injured—fell from engine	30
Ill. Cent.	July 22	Finger mashed—car and barrel	42
Ill. Cent.	Oct. 13	Back injured—fell on engine deck	31
Ill. Cent.	Oct. 18	Head injured—engine and car	30
Ill. Cent.	Nov. 4	Head cut—engine and car	31
Ill. Cent.	Nov. 16	Head injured—engine and signal staff	44
Ill. Cent.	Nov. 20	Leg broken—fell from engine	†
Ill. Cent.	Dec. 28	Collar bone broken—car and engine	102
L. S. & M. S.	Jan. 23	Body injured—fell from car	36
M. and C.	Apr. 2	Foot injured—falling coal	32
M. and C.	Aug. 10	Arm broken—fell from engine	47
M. and C.	Dec. 13	Back injured—falling coal	73
St. L. I. N. & S.	Feb. 20	Ankle broken—collision	180
St. L. I. N. & S.	June 8	Leg burned—hot water	55
St. L. I. N. & S.	Nov. 28	Shoulder injured—fell from tank	36
St. L. Br. Term'l	Dec. 3	Collar bone broken—fell from engine	60
St. L. Troy & E.	Sept. 25	Leg amputated—run over by car	*
S. E. Co.	June 17	Body injured—engine derailed	35
T. P. & W.	Apr. 3	Body injured—collision	36
Vandalia	Apr. 9	Eye injured—flying coal	34

* Permanent. † Over 30 days.

Because the above table includes only injuries causing disability for more than 30 days, the number included is relatively small. Of the 56 accidents here listed, the number of days

lost is given for 53 cases and amounted to 3,031 days, or an average of 57.4 days per injury. The table indicates the general hazard of the occupation by the uniform manner in which the injuries affected the different parts of the body; head injuries number 10, trunk injuries 16, arm injuries 12, and leg injuries 18. Bone fractures number 23, or 50 per cent. of the total. In most industries, the risk of injuries is usually limited to one part of the body and it is possible to provide safety appliances to prevent accidents. The firemen's occupation, however, exposes his whole body and there seems to be practically no means of protecting him against the inherent hazard of his employment.

Occupational Diseases.

The diseases connected with the occupation of locomotive fireman are of the same kind as occur in other occupations, but affect firemen in a greater degree than other employees because of the conditions connected with the firemen's work. Special classes of diseases peculiar to certain occupations, such as miners' asthma, or metal poisoning (lead, arsenic, etc.), do not occur in the case of firemen.

The experience of the mutual insurance organization of the Brotherhood of Locomotive Firemen and Enginemen is practically the only source of information on this subject available at the present time. A table compiled by this organization gives a comparison of its experience with that of two large fraternal insurance societies; this table is as follows:

TABLE XV.

MORTALITY EXPERIENCE OF BROTHERHOOD OF LOCOMOTIVE FIREMEN, MODERN WOODMEN OF AMERICA, AND WOODMEN OF THE WORLD, SELECTED BY CAUSES.

(Source: Eastern Concerted Wage Movement, p. 332.)

Cause of Death or Disability.	Modern Woodmen of America. Number of Members Exposed to Risk in 27 Years was 10,238,726.			Brotherhood of Locomotive Firemen and Enginemen. Number of Members Exposed to Risk in 31 Years was 1,125,606.			Woodmen of the World. Number of Members Exposed to Risk in 20 Years was 3,803,740.		
	Number of Claims.	Rate per 1,000 Members Exposed.	Per Cent. of Loss.	Number of Claims.	Rate per 1,000 Members Exposed.	Per Cent. of Loss.	Number of Claims.	Rate per 1,000 Members Exposed.	Per Cent. of Loss.
Typhoid fever	4,108	.4012	7.64	735	.653	6.95	2,673	.7024	8.55
Tuberculosis	7,907	.77225	14.71	1,012	.899	9.58	4,277	1.1239	13.69
General disease, inc. cancer	4,680	.4570	8.70	194	.1723	1.83	2,334	.6134	7.79
Heart disease and other circulatory disease	7,162	.6995	13.32	461	.4095	4.36	2,426	.6375	7.76
Bright's disease and other genito-urinary disease	3,405	.33255	6.33	339	.3010	3.20	2,307	.6062	7.38
Other zymotic disease	1,993	.19465	3.71	436	.3873	4.12	1,519	.3992	4.86
Pneumonia	4,912	.4797	9.14	394	.3499	3.73	3,582	.9413	11.42
Other respiratory disease	918	.08965	1.71	53	.0470	.50	620	.1629	1.98
Digestive disease	4,989	.4872	9.28	416	.3694	3.93	2,923	.7681	9.25
Nervous disease	4,177	.40795	7.77	625	.5552	5.91	2,126	.5587	6.80
Violence, including suicide and amputations	8,665	.8463	16.12	5,587	4.9635	52.86	5,101	1.3415	16.32
Blindness	......	......	......	163	.1448	1.54	......	......	......
Unclassified	847	.0827	1.57	153	.1359	1.45	1,258	.3306	4.03
Total	53,763	5.25065	100.00	10,568	9.3878	99.96	31,146	8.1857	99.94

The rates given in the preceding table are suggestive in certain regards. Of the three societies, the Modern Woodmen have the most favorable general rate (5.25 per 1,000 members); the rate for the Woodmen of the World is 8.1857 and for the firemen 9.3878 per 1,000 members. The firemen's rate, however, includes the extremely high rate of 4.9635 for violence, etc. Next to this rate, that for blindness is conspicuous. This high rate is in part caused by exposure to the heat and strong light of the firebox on the locomotive.* It is evident that loss or impairment of eyesight must be considered an occupational disease of firemen. The detailed tables prepared by the firemen's insurance organization show a surprising number of injuries to the eyes from bursting of water glasses or other gauges.

* Eastern Concerted Wage Movement, pp. 289 to 304, 315–320. See also Proceedings before the Board of Arbitration, 1913, pp. 457–513.

The preceding table, unfortunately, provides no information as to the age grouping of the various societies. Undoubtedly the organization of the firemen, with its large proportion of young men, should have a low rate for heart disease and circulatory disease—perhaps even lower than that shown in the table. The rate for nervous diseases is high, though not higher than that of the Woodmen of the World; here again, the influence of the age grouping is probably the decisive factor.

General Conclusions.

There is general agreement that the occupation of locomotive fireman is "extra hazardous."

There is general agreement that the mortality rate of locomotive firemen is higher than that for engineers.

Two special studies of mortality conducted by the Actuarial Society of America show that the occupation of locomotive firemen has a higher death rate than the rate for engineer, express messenger, mail clerk, passenger trainman, passenger conductor, and track supervisor.

As compared with other hazardous occupations, locomotive firemen have a mortality rate which is about the same as that for anthracite miners, but is higher than the rate for potters, for structural iron workers, for locomotive engineers, etc.

Fatal accidents cause about 50 per cent. of the deaths of the members of the firemen's insurance organization. Fatal accidents occur more frequently to firemen than to any other occupation included in the Medico-Actuarial Investigation; they were, for instance, distinctly more frequent than for miners of any kind, or for structural iron workers.

The standard rating of accident insurance companies groups locomotive firemen in the most dangerous class for which they accept insurance.

The risk of temporary disablement and of permanent partial disablement is 50 per cent. higher for firemen than it is for engineers.

The fireman seems to be more exposed to injuries like strains and sprains (which cause greater loss of time than other injuries) than any other group of railway employees.

The fireman's injuries affect all parts of his body and special protection against them seems impossible. Fractured bones are a conspicuous feature of his injuries.

Loss and impairment of eyesight and liability to nervous disease are special hazards of the fireman's occupation.

While part of the fireman's risk is due to the fact that the "new-comer" in any occupation has a high accident rate, the general hazard of the occupation is so great as to be principally responsible for the high rates for death and injury.

LIST OF SOURCES.

Actuarial society of America. Experience of thirty-four life companies upon ninety-eight special classes of risks. Comp. and pub. by the Actuarial society of America. New York, 1903.

American academy of railway surgeons. Report of the . . . . annual meeting. Chicago.

Board of arbitration in the controversy between the eastern railroads and the Brotherhood of Locomotive Firemen and Enginemen, 1913. Proceedings. Arbitration between the eastern railroads and the Brotherhood of Locomotive Firemen and Enginemen submitted to arbitration, under the Erdman act, by agreement dated Feb. 18, 1913. At Waldorf Astoria hotel, New York, March 10–April 5, 1913. New York, 1913. In 4 volumes.

Braehmer, O. Eisenbahnhygiene, von Dr. Otto Brämer. 2. Aufl. Unter Mitwirkung der Herren Geheimen Bauräte Bathmann und Bork in Berlin und Schumacher in Potsdam, neu bearb. von Dr. Ernst Schwechten. Mit 28 Tafeln, einer Karte und 81 Abbildungen im Text. Jena, G. Fischer, 1904.

Braun, H. Die Sterblichkeits- und Invaliditäts-verhältnisse des Locomotivpersonals deutscher Eisenbahnen. *In* Zeitschrift f. d. ges. Versicherungs-wissenschaft, 1911, pages 429 ff. and 635 ff.

Brotherhood of Locomotive Firemen and Enginemen. International president. Eastern concerted wage movement, 1912–1913. Supplemental report of the International president, Brotherhood of Locomotive Firemen and Enginemen, for the three months ending March 31, 1913. n. p. 1913.

Classification of occupations for accident and health insurance. As approved by International association of accident underwriters. Rev. and cor. to February 1, 1912. New York. 1912.

Crum, F. S. Accidents to railroad employees in New Jersey, 1888 to 1907. *In* Bulletin of U. S. Bureau of Labor, No. 84.

Hayes, D. A. Length of the trade life in the glass bottle industry. *In* Annals of the American Academy of Political and Social Science, May, 1906.

Hoffman, F. L. Industrial accidents and trade diseases in the United States. *In* Transactions of the fifteenth International Congress on Hygiene and Demography, vol. 1, pp. 763 ff.

Hoffman, F. L. Physical and Medical Aspects of Labor and Industry. *In* Annals of the American Academy of Political and Social Science, May, 1906.

Hunter, A. Mortality among Insured Lives engaged in certain Occupations involving additional hazard, such as liquor dealers, railroad men, miners, policemen and electricians. *In* Transactions of the Actuarial society of America, May, 1907 (vol. X, no. 37).

Medico-actuarial mortality investigation. Comp. and pub. by the Association of life insurance medical directors and the Actuarial society of America. New York, 1912–13. In 4 volumes.

Volume III is entitled "Effect of Occupation on Mortality."

New York Life Insurance Co. Treatment of applicants engaged in occupations which involve some additional hazard. Form 1519. May, 1912 (pamphlet, 12 pp.).

O'Connell, J. The Manhood tribute to the modern machine: influences determining the length of the trade life among machinists. *In* Annals of the American Academy of Political and Social Science, May, 1906.

Oliver, Sir. Thomas. Dangerous trades: the historical, social, and legal aspects of industrial occupations as affecting health, by a number of experts; ed. by Thomas Oliver. London, J. Murray, 1902.

Overlock, M. G. The working people: their health and how to protect it, by M. G. Overlock. Worcester, Mass., The Blanchard press, 1910.

Prinzing, F. Handbuch der medizinischen Statistik. Von dr. med. Friedrich Prinzing. Jena, G. Fischer, 1906.

Prudential insurance company of America, Newark, N. J. Exhibits of the Prudential insurance company of America, International congress on hygiene and demography, Washington, D. C., September, nineteen twelve. Newark, Prudential press, 1912.

General mortality data of particular occupations.

Risser —. Etablissement d'une table provisoire de mortalité des ouvriers mineurs dans les mines de combustibles minéraux et dans les antres mines (France). *In* Bulletin trimestriel de 'l'Institut des Actuaires Français, No. 95.

U. S. Bureau of the Census. Thirteenth Census, 1910. Population, vol. IV, Occupation Statistics.

U. S. Bureau of the Census. Mortality statistics, 1909. Tenth annual report with revised rates for the intercensal years 1901 to 1909, based upon the census of 1910. Washington, 1912.

U. S. Bureau of labor. Workmen's insurance and benefit funds in the United States. Washington, Govt. print. off., 1909. (Annual report of the commissioner of labor, 23d, 1908.)

Issued also in the Congressional series, no. 5494, as House doc. 1565, 60th Cong., 2d sess.

U. S. Employers' liability and workmen's compensation commission. Message of the President of the U. S. transmitting the report of the Employers' liability and workmen's compensation commission,—together with the hearings held before the commission. Washington, Govt. print. off., 1912.

Westergaard, H. Die Lehre von der Mortalität und Morbilität. Anthropologisch-statistische Untersuchungen, von Harald Westergaard 2. vollständig umgearb. Aufl. Jena, G. Fischer, 1901.

Zeitschrift für die gesamte Versicherungs-wissenschaft; hrsg. vom Deutschen Verein für Versicherungs-wissenschaft. Berlin, E. S. Mittler und Sohn.

VITAL STATISTICS—THE WHITE SLAVE OF SANITATION.*

By Cressy L. Wilbur, M.D., *Director of Vital Statistics, New York State Department of Health, Albany.*†

Vital statistics are almost universally recognized by practical sanitarians to be the absolutely necessary bases of all progressive, modern public health work. What we call State Medicine undoubtedly owes its origin to the systematic collection and study of the vital facts of human life first carried out in the splendid series of English reports of the Registrar-General begun by Dr. William Farr nearly eighty years ago (1837). Today it should scarcely require explanation or argument, especially before an audience of medical men—and women—to show that the city, state, or country that continues to dwell in ignorance of its exact sanitary condition, as shown by absolutely reliable vital statistics, is an anachronism, a relic of the dark ages, fitter for association with those who still believe in witchcraft and amulets than with the scientific sanitarians of the present day.

It is unnecessary, but I love to quote the emphatic declaration of Doctor Fulton, Secretary-General of the International Congress on Tuberculosis and of the International Congress of Hygiene and Demography, the accomplished and experienced executive officer of the Maryland State Board of Health—a state, by the way, which in common with New York is now putting into effect a system of district sanitary supervisors or health officers, the results of which will undoubtedly be of much interest in connection with a similar plan of sanitary organization proposed for Michigan. Doctor Fulton said:

"Public hygiene is built upon, is controlled and directed by, and is everlastingly in debt to vital statistics. The might and the right to direct the future of preventive medicine, to make and to terminate contracts, to approve and reject risks, to test materials and methods, to invest means and distribute

*Paper read before the Michigan State Medical Society, Lansing, September 10, 1914.

† Chief Statistician for Vital Statistics, 1906–14, U. S. Bureau of the Census, Department of Commerce.

profits, these things belong inalienably to vital statistics. Every wheel that turns in the service of public health must be belted to this shaft, otherwise preventive medicine must remain invertebrate and unable to realize the profits available from the magnificent offerings of collateral sciences. If the unborn historian of hygiene in the twentieth century shall find one anomaly more curious than any other, it will be that the twentieth century, opening with prodigious resources, immediately available, ran a third or half its course before these resources became so standardized that each unit of power might be accounted for in a definite scheme of vital statistics."

Today every public health official, every enlightened physician, every earnest social worker demands the aid of accurate vital statistics. The great life insurance companies are in the field for longer and better human life—not from selfish motives of saving dollars and cents through the prolongation of the lives and usefulness of their policyholders, but, as I believe, through the purest altruistic motives. As a sample of the splendid work performed by the statisticians and medical officers of prominent life insurance companies, Hoffman, Rittenhouse, Marsh, and many others, I may quote from a leaflet recently gotten out by Dr. Louis I. Dublin, Statistician of the Metropolitan, under the title, "Why States Should Support Vital Statistics."

Doctor Dublin says; "Vital statistics is a system of accounting for human life. Just as the business man gets accurate information for the proper management of his affairs, so the State should secure knowledge of the nature and extent of its vital resources. Without vital statistics, the State cannot know how best to safeguard the health and prosperity of its citizenship. Births, marriages and divorces, and cases of sickness and death are facts with which the modern State is most concerned. They correspond to the income and disbursements of the business man. A balance sheet properly kept—[note the words "properly kept"]—by the State shows whether or not progress is being made. . . . Statistics of sickness and death are among the community's chief means of preventing suffering and saving life. The health officer

must know where cases of contagious diseases are found; for only in this way can he check epidemics and protect the people. Death certificates tell the modern health officer just what are the chief weaknesses in his sanitary arrangements. Too many cases of typhoid fever point to a bad water supply, to an inadequate sewerage system, or to polluted milk. A large number of deaths from tuberculosis points out a distinct health policy to the community and tells definitely whether the facilities at hand are sufficient to cope with the situation. Today, no community can properly safeguard the health of its people if it has not at hand accurate and complete statistics of sickness and death."

"Accurate and complete statistics of sickness and death!" Have you accurate and complete statistics of sickness in Michigan? Are even your statistics of deaths—and of births also, because the exceedingly important ratio of infantile mortality depends upon complete registration of all births that occur—accurate and complete as they should be for the protection of the interests of all citizens of the state, and especially of the children born therein? Your answer must be No; and yet Michigan is far in advance of many states of the Union with respect to the registration of vital statistics, and was, at one time, thanks to that grand pioneer sanitarian whom, to the eternal disgrace of the state, Michigan has neglected to honor as he has well deserved, a leader not only in the United States but in the world in this most fundamental matter of statistics of sickness. I refer to Dr. Henry B. Baker, for many years Secretary of the Michigan State Board of Health. He put Michigan on the map in a sanitary sense, when doctors were quarrelling as to whether scarlet fever and diphtheria were infectious, and later arguing in a similar way about tuberculosis. "A prophet is not without honor save in his own country." Here is what Assistant Surgeon-General John W. Trask, United States Public Health Service, in his recently published monograph, "Vital Statistics—A Discussion of What They Are and Their Use in Public Health Administration," says of Doctor Baker's epoch-making work:

"Massachusetts and Michigan were pioneers in the collection of information regarding the prevalence of disease. . . .

"Early development in Michigan. The plan which the Massachusetts State Board of Health adopted in 1874 of furnishing postal-card blanks to voluntary correspondents for the purpose of collecting weekly information of the prevalence of disease was adopted by the Michigan State Board of Health in 1876. In its annual report for the year the State Board of Health in referring to the matter states, 'A knowledge of the nature and extent of prevalence of at least the several prominent diseases throughout the State has from the first organization of the board been considered desirable.'"

* * * * *

"The Michigan law seems to be the first one looking to the comprehensive collection of information in regard to the prevalence of disease, and for a number of years the work was carried on with intelligence and perseverance under the able supervision of Dr. Henry B. Baker, Secretary of the State Board of Health. Doctor Baker was truly a pioneer in this work and many years ahead of his time in his appreciation of its importance."

I believe that you will all concur with me in this magnificent tribute, from the head of the Government work in morbidity statistics, to Dr. Henry B. Baker, a citizen of Michigan. Ousted from the important office of executive health officer of Mighican by the agency of cheap and nasty political "workers" —I will not disgrace the name of "politician," which may be used in an honorable sense, by applying it to such Grylles, to whom the valuable reports and collections of sanitary and statistical documents made through many years by Doctor Baker were indeed "pearls"—they went to the junk-dealer or the bonfire—the record of Michigan, my native State, and whose honor is indeed dear to me, in the treatment of its pioneer sanitarian, is, and will be forever, a disgrace to the people of the State of Michigan, and to its medical profession—if they only realized, and thoroughly comprehended, what a grievous thing they have permitted to be done.

I have spoken with some feeling in this matter for I owe personally a very large debt to Doctor Baker. When I assumed the direction of the Michigan vital statistics back in '93 at a time when they were merely a laughing-stock for incom-

pleteness and general worthlessness, it was Doctor Baker to whom I turned for advice and helpful counsel in every emergency. You may recall, perhaps, at least some of the older members of this Society may recall, the first paper that I ever prepared for an audience on vital statistics, which was presented at the annual meeting of the Michigan State Medical Society at Grand Rapids in 1894, and discussed by Doctor Baker. From that date, with the help of Doctor Baker, Dr. George E. Ranney of Lansing, Dr. Leartus Connor of Detroit, Dr. Eugene Boise of Grand Rapids, Dr. A. W. Alvord of Battle Creek, and other members of this Society, began the movement which resulted in the passage of a modern vital statistics law for Michigan, a law which, in all essential details, was identical with what is now known as the "Model Law," recommended by the American Public Health Association, the American Medical Association, the Bureau of the Census, and now in practical and successful operation in a score of states—among which, I am glad to say, since January 1, 1914, may be numbered New York. And the Michigan law, in turn, was based largely upon the work of Dr. Elisha Harris of New York; so the circle returns.

I said that all modern public-health workers were convinced of the importance of accurate vital statistics as a basis for their efforts. Unfortunately, this statement is not quite true, at least for the United States. This country is far in the rear of other civilized nations with respect to vital statistics, due to the fact that each of the forty-eight sovereign states must legislate for itself. In going about the country during the past dozen years for the purpose of promoting the passage and enforcement of good registration laws, I have come upon some curious experiences. I am glad to say that the value of vital statistics is almost everywhere recognized; the growth of the registration area from about two fifths of the total population in 1900 to nearly two thirds in 1913 is evidence of this fact. Most of all, during very recent years, is the enthusiastic growth of registration territory in the South, an important portion of the country which, prior to 1911 when Kentucky was admitted, had no registration state. Now good laws are in effect in Virginia, North Carolina, Tennessee, Arkansas,

Mississippi, Louisiana, besides a bill passed by both branches of the South Carolina Legislature and still awaiting approval*—or rejection—by Governor Blease. Every state in the Union at the present time has some form of state law for this purpose, not always a good law but at least some legal recognition of the importance of vital statistics to the community, with one exception. That is the State of Georgia, and I hope that before this paper is presented, the earnest efforts of many citizens of that State and the able editorials and articles on the subject in a large proportion of the state press will be rewarded by the passage of a good law.

Curiously enough, Georgia, the most backward of all American states up to the present time with respect to the keeping of records of the births and deaths of its people, presents the only state sanitary organization that I have ever heard of to go on record as disparaging the practical value of vital statistics for sanitary work. The condition is so unique, and so amusing in these days of sanitary progress, that I may quote briefly from a long letter officially signed by Emory R. Park, M.D., Director Publicity Department of the Georgia State Board of Health, as printed in the *Atlanta Journal*, June 10, 1914, and also from a scathing editorial in the same issue by Mr. James R. Gray, under the caption "Remarkable!" from which it appears how far lay public sentiment may be in advance of benighted and fossilized so-called "professional" opinion.

Here are some gems from Doctor Park's contribution to sanitary and statistical science:

"We beg to state that in our opinion there is no more striking example of the fallacy of figures than in the collection of vital statistics. . . . we think it is of a great deal more importance to the health and treasury of Georgia for the commonwealth to provide county boards of health, county health officers, and money sufficient to enforce our health laws, than it would be for the state to spend several thousands of dollars annually in collecting mere figures which tend to show how many died of this and how many of that disease."

"While we do believe that vital statistics are of some value to public health officials in fighting disease, we most positively

* Approved September 1, 1914.

do not think that vital statistics are essential. While it would be convenient in some respects to be able to know that here so many died of this and there so many of that disease during such and such a period, still this luxury can be, at least for the present, dispensed with. We all know that preventable disease stalks in our midst constantly [possibly it would not "stalk" so constantly in your "midst" if you had a little precise information about its occurrence], and it is no more essential for the medical profession to know just how many died of such and such a cause in order to give the profession a correct point to work from in a campaign against disease than it is essential for lawyers and sheriffs to know just how many people were murdered last year to enable them to start or continue a campaign this year against crime." [!]

Referring to Cabot's and Oertel's misunderstood criticisms of diagnoses of causes of death, which, so far as they are well-founded, apply with even greater force to those daily diagnoses employed by the physician for the treatment of disease, he says:

"Taking our population as a basis, one could easily [note the foolish word], from statistics gathered in other parts of the country [Georgia, a mere parasitic State, sucking nutriment from more progressive communities; the whole is a sad advertisement of health conditions in Georgia and a terrible arraignment of ignorant and incapable health direction]—since the proportion of error is quite as great as it would be here, and probably following the same general lines—in a few hours give to Georgia statistics that would be in every way as reliable as those that could be collected under present conditions."

In which last remark I most cordially agree with Doctor Park, it being understood that the "present conditions" refers to collection by the state health authorities, concerning whom Doctor Park explicitly stated that the letter was prepared by "our desire to give to the people of Georgia the benefit of their board of health's opinion on this subject, the importance of which is often inadvertently overrated."

Says Mr. Gray, in editorial comment:

"Angels and ministers of grace defend us! Do business corporations regard book-keeping as a luxury? Shall the State

regard life-and-death book-keeping as a luxury? Is it merely a 'convenience' to know the extent and the area of particular diseases, to know whether they are diminishing or increasing, to know just where and how to direct health campaigns for the accomplishment of definite and enduring results?

* * * * *

"It is due our State Board of Health, as well as the rank and file of our people, that the Legislature establish a vital statistics bureau for Georgia. If it be audacious to insist upon this point, in the teeth of the highly original communication we publish elsewhere, we can only fall back upon the opinion of the State Medical Association, of national health authorities, of the national census bureau, and upon the example of forty-seven States who, in this respect, have left Georgia 'in the dark backward and abysm of time.'"*

So much for Georgia! But before you laugh, or at least before you laugh too consumedly, do you remember when physicians in Michigan were protesting against reporting scarlet fever and diphtheria? And bullyragging Doctor Baker and the State Board of Health because "consumption" had been made a reportable disease? Considerable water has gone under the mill since that time, but are you, as physicians, promptly reporting your cases of communicable diseases today, as required by law? Do you report all births within the limit set by law? And do you, as members of County Societies and of the great State organization, uphold the hands of the administrative officers of public health and vital statistics and demand that those laws be enforced, to the letter, with punishment of the negligent and lazy, even though they be your professional brethren in high standing, for the benefit of the people of the state?

It is not yet time to smile at other states!

While I think he is exceedingly misguided and uninformed, I admire Doctor Park's outspoken statement of his position and that of the Georgia State Board of Health, and greatly prefer it to the hypocrisy that talks long and, apparently, with earnestness of the "value of vital statistics," then nullifies or prevents all successful work in that direction for the

*A vital statistics bill was passed by the Georgia legislature August 7, 1914.

sake of personal or professional "graft." Or that, recognizing the need of accurate vital statistics in the state, permits political grafters to make patronage out of registration laws and to barter their enforcement for party or personal help.

Vital statistics has been more prostituted to base political ends than any other branch of public health work. This is why I chose the title for this paper—"Vital Statistics—the White Slave of Sanitation"—because the "rotten vital statistics" with which this country is afflicted are largely due to the lack of protection and encouragement for trained statistical workers, and security of tenure against the personal and political attacks often made as a result of conscientious enforcement of law. The medical profession is too often careless, perhaps deceived by some influential physician who assumes the right to violate the law at his will, and health officers and registrars are afraid, with reason, to do their manifest duty.

Whoever tampers with public health—and vital statistics, except perhaps in Georgia, is the absolutely necessary basis of public health—is a criminal. Doctor Vaughan has said, I believe, that when a death from typhoid fever occurs somebody ought to be considered a murderer and punished accordingly. Certainly, in my judgment, the members of a City Council who, knowingly and for their personal profit, delay the installation of a proper system of water supply, thereby causing needless deaths, are guilty of murder and should be treated with far greater severity than the criminal who slays in a moment of passion. And a great state medical organization, prating for years of the importance of vital statistics and knowing absolutely, as no competent sanitarian doubts for a moment, that reliable vital statistics means the saving of lives—what shall we think of medical men who defer, even for a month or a year, the effective registration of vital statistics in order to protect their semi-political organization and escape the mortification of renouncing the ineffective agencies with which they have gold-bricked their own state? Is true state love and patriotism dead that men care more for power and self-aggrandizing machinery than for human lives—at least their neighbors' children—that might be saved by using the results of effective registration of vital statistics? Give

me Doctor Park, in preference to such traitors to their state and to their profession, every time!

We are cultivating a keener sense for, and a sharper distaste of, graft with the passing of every year. Conditions that existed even a decade ago are unthinkable now. The public conscience is awakening, if not yet fully awake. Why here in this Capitol building, ten years ago, I well recall the scorn with which a member of the Legislature resented the imputation that the possession of railway passes might influence his vote, or at least his attitude, toward railway measures. And this year in Congress the 20-cent mileage (feature of the appropriation bill) was almost done away with. Graft may be defined as the obtaining of money, or other reward, for services not performed. It includes the farming-out of state employment, which should be strictly under a thoroughly enforced and protected civil service, to further the political or personal ends of individuals. It creeps in in unexpected places, in city, state, even in Federal government affairs. Why, do you know that this year, Anno Domini 1914, on the twentieth of July, the registration area of the United States—an area which it has taken many years of devoted work and hearty coöperation on the part of the Federal and State authorities to build up, was practically absolutely destroyed? I do not suppose that a single member of Congress knew of the gravity of the situation. Indeed, I do not know that since the foundation of the Government even one member of Congress has given a single moment of his time to the constructive consideration of the great problem, underlying all our efforts for efficient public-health work on a national scale in this country, of how shall the United States obtain effective registration of vital statistics for the country as a whole. Few indeed have given even the most casual consideration, and even the measures recommended by the American Medical Association were most defective in this important respect. While I believe that the problem will be solved, and that—as most particularly, in some very important respects, a problem of State Medicine—it will be solved by the National Department of Public Health which is sure, some day, to be established, while the present ignorance and indifference of the medical profes-

sion to this fundamental matter of thorough enforcement of registration laws continue, the experiment would be very dangerous. Vital statistics must be protected from graft, and the meanest kind of graft is the peddling of cheap appointments and the displacement of trained and conscientious workers in this field.

Graft is the payment for services not rendered. When the Michigan State Medical Society went before the Legislature in 1895 and 1897, through its committees, they took pains to declare that the proposed law was not for the special benefit of the doctors of the State; nay more, that it imposed certain duties upon physicians without giving them special compensation therefor. Experience has demonstrated that such compensation does not procure complete registration. But after the law was passed, committees of certain county societies procured an amendment giving physicians and midwives fifty cents for each birth. It did not improve the completeness of the returns to any extent if at all. While the individual physician may with propriety receive any fee granted him by state law, how does the organized profession stand with respect to the compensation paid for complete returns and the value therefor not delivered? Does it come under the definition of graft, and would it be well to appoint a committee to consider the propriety of using the whole force of this Society, State and County organizations alike, to "deliver the goods," or else cut out the belittling fee and support the authorities in the thorough enforcement of law, by means of the penalties thereof when found necessary?

Just as I left Albany I had the pleasure of receiving a copy of the splendid address of your President, Doctor Kiefer, and as I write I have just enjoyed the privilege of reading the remarks of Doctor Sawyer. The earnestness of these addresses, which I may take as representative of the active spirit of sanitary advancement now animating the Michigan State Medical Society, demands that I should render to you, as a loyal member of this Society and a citizen of Michigan—until the establishment of my residence in New York—the best information and judgment of which I am capable relative to the condition and conduct of the work in vital statistics in Michigan, my

native State, whose registration service I had the honor to establish and conduct for thirteen years prior to my service as Chief Statistician of the United States Census Bureau, which terminated on July 31, 1914.

Vital statistics in Michigan, as elsewhere, is an essential part of the public health administration. It can not be satisfactorily and successfully conducted except under medical direction as a part of the public health department of the State. All states in which this work has been separated from the public health service have seen their vital statistics undergo a species of dry-rot, in which the important duties of registration and use of vital statistics have degenerated into a mere perfunctory clerical or political administration. Michigan has taken no part in recent years in the national advancement of vital statistics, and has failed to realize the benefits that would have been readily available as a result of the excellent Michigan law. The service has been prostituted to the dirty expedients of political requirements, and the wages of faithful workers have been diverted to the support of political parasites.

The remedy for this condition is reorganization, on a civil service basis if possible, but most emphatically with the absolute elimination of political favoritism and of those who have prostituted the public service for private ends; the establishment of the vital statistics work as an essential, fundamental, honored, and adequately equipped branch of the state health department; and I believe also most earnestly, from my experience in the administration of the New York law, with the organic coöperation of the district supervisors to be provided under a general public health law of the type of the Amberson bill. Under such conditions the sanitary and registration work of the State would again come rapidly to the front, and the rich dividends of human lives saved from disease and death would make us wonder why this step had been so long delayed.

THE DECADENCE OF THE NATIVE AMERICAN STOCK. A STATISTICAL STUDY OF GENEALOGICAL RECORDS.

By Frederick S. Crum.

In 1905, Mr. Frank N. Hagar wrote a book entitled "The American Family," and in his search for the bond of family unity—the tie which binds human couples together when all or most other bonds are withdrawn—he found it in the child.

> Couples alone with this tie need all the possible stimulating of otherwise conjugal love, the obligations, the imprecations of conscience and of society—perhaps the fear of the law, to hold them firm . . . where children are feared, eschewed, or avoided, the deadly seeds of family discord are ever ready to spring up, take root and cause the decay of family unity. When among any people a general practice of child prevention becomes prevalent, that deadly ax has cut the very tap-root of the family, of its unity, its life, its persistence, and with it the life and persistence of that people and its institutions.

Again, in an earlier chapter entitled "Decadence of Northern Yankees," Mr. Hagar stated as follows:

> There seems to be one central cause that strikes at the family that is nurtured here, and which the foreigner reared abroad has escaped:—it is a theory that ignores reproduction, that violates the principles of love and domestic association, and that began more obviously in fearing childhood and avoiding parenthood.

As early as 1897 I became interested in the problem with which this nation is confronted in the appalling decrease in the birth-rate of its native stock—the descendants of the founders and builders of this great Republic. An investigation made at that time into the birth-rate of Massachusetts during the period 1850 to 1890 revealed only too clearly the decline in the birth-rate of that commonwealth, and the phenomenon was particularly noticeable in the native element of the population. That investigation only confirmed the results of previous inquiries and notably that instituted in the Massachusetts State Census of 1885 whereby it was shown that 20.2 per cent. of the native married women were without

children as against 13.3 per cent. of the married women of foreign birth. Again, that census of 1885 showed the average number of children living per each native married woman to have been 1.92, against 3.01 for the married women of foreign birth.

Other careful investigators of the subject, including R. R. Kuczynski* in 1901 and 1902, Allyn A. Young† in 1905, and Frederick L. Hoffman‡ in 1909, all interpret the best available data in the same way and all arrive at the same general conclusion, namely, that the native element is failing to contribute anything like its proper quota to the new population of this country.

Not satisfied with the limited data of determining value available in the census and registration reports, I have made a statistical analysis of twenty-two genealogical records of pioneer families which originally settled in New England or the middle Atlantic states. The results of this inquiry confirm all the direst forebodings of those who have preached most strenuously against race suicide. The results briefly set forth in the following table may be considered absolutely reliable and representative of the true state of affairs in the native element of the population north of the Mason and Dixon line.

TABLE I.

AVERAGE NUMBER OF CHILDREN PER WIFE.

(Statistics Based upon Twenty-two Genealogical Records* of American Families.)

Marriage Periods.	Number of Wives.	Number of Children	Average Number of Children per Wife.
Previous to 1700.	276	2,034	7.37
1700–1749	802	5,478	6.83
1750–1799	1,966	12,649	6.43
1800–1849.	5,530	27,320	4.94
1850–1869.	3,062	10,630	3.47
1870–1879.	1,086	3,004	2.77
Totals.	12,722	61,115	4.80

* Only carefully edited genealogical records were used.

This table reveals most clearly the decadence of the original stock which with almost boundless energy "cleared the forests,

* The Fecundity of the Native and Foreign-Born Population in Massachusetts. The Quar. Jour. of Economics, Nov., 1901 and Feb., 1902.

† The Birth-Rate in New Hampshire. Quarterly Publications of the Am. Stat. Assn., Sept., 1905.

‡ The Decline in the Birth-Rate. The North American Review, May, 1909. Maternity Statistics of the State of Rhode Island, State Census of 1905. Proceedings of the First International Eugenics Congress, London, 1912.

gleaned the uneven fields from the glacial stone drift, built in quick time their homely cabins, and moving from tract to tract like a collective array of nature's life, even as the animals and plants, spread with their increasing sons and daughters." Continuing, Mr. Hagar truly says: "They would have laughed to scorn at the modern task of doing so simple a thing as to raise a child. Their women in addition to the work of their large families, and of ordinary housekeeping without modern improvements, performed nearly all the labor that is now done in factories and shops in fitting raw material for use as clothing and food." An average per wife of 7.37 children in the seventeenth century, was 4.60 more than for wives of their descendants married during the ten years, 1870 to 1879! Later data are difficult to secure in sufficient number to be reliable, for at least thirty years must be allowed from the date of the marriage to the closing of the record of the children resulting therefrom.

It goes without saying that a reduction in the average number of children per wife from 7.37 to 2.77 has not been fully offset by reduced infant mortality. There is fragmentary evidence, too, in census returns and other sources, that the present-day average number of children in *completed* American families is considerably less than 2.77 per wife. In fact, it is very doubtful if the present-day average is as high as two children per native American wife. Comment upon this condition of affairs is unnecessary at this time except that it may be stated that the facts available in the most reliable sources seem to indicate that the native American stock has reached the point where it is failing to maintain itself, that is, its births are quite certainly fewer than its deaths at the present time.

If the seventeenth century average had prevailed in the 1,086 families reported for 1870–1879, they would have produced 4,996 more children than were actually recorded. In the eighteenth century, the size of the family was fully sufficient to populate a new country in a normal way. From the beginning of the nineteenth century, however, the decline in the birth-rate of the native stock has been so rapid as to preclude any conclusion other than that it has been deliberate

and largely the result of selfish motives. Such evidence as is available from the most recently compiled genealogies and from such external evidence as must be obvious to all careful observers of present-day conditions, it is quite clear that when sufficient data are available for marriages subsequent to 1880, the average number of children per native wife will be found to have fallen to at most two, and probably less.

Genealogical records, however, do not tell the whole story. There are fewer marriages in proportion to the persons of marriageable age than in the early days and there are more childless wives, some of whom are almost necessarily omitted from statistics based upon genealogical records.

Every careful observer of present-day tendencies has noted and many have commented upon the fact that childless marriages, particularly among Americans of native stock, appear to be, proportionately to the total married women of that stock, rapidly increasing. The following brief summary of the 12,722 wives included in this genealogical investigation is of exceptional interest:

TABLE II.

NUMBER AND PERCENTAGE OF CHILDLESS WIVES.

Statistics of 12,722 Wives included in Twenty-two Genealogical Records.

Period.	Total Number of Wives.	Childless Wives.	
		Number.	Per cent. of Total
Previous to 1700	276	5	1.81
1700–1749	802	14	1.74
1750–1799	1,966	37	1.88
1800–1849	5,530	225	4.07
1850–1869	3,063	181	5.91
1870–1879	1,086	88	8.10

In the seventeenth and eighteenth centuries less than 2 per cent. of the wives were childless; in the first half of the nineteenth century the proportion jumped to over 4 per cent., and this latter figure had doubled by 1870 to 1879. In census and other sources there is evidence that at present there is a far larger proportion of childless wives among the native American women than is indicated by the statistics here presented for the decade 1870 to 1879.

Closely related to the subject of childless wives is that of the number of children borne by the mothers. The following summary table brings out some significant facts:

TABLE III.

COMPARATIVE FECUNDITY OF NATIVE AMERICAN MOTHERS.

Statistics of 12,172 Mothers included in Twenty-two Genealogical Records.

Period.	Mothers with only One Child.		Mothers with only Two Children.		Mothers with Three to Five Children.		Mothers with Six to Nine Children.		Mothers with Ten or More Children.	
	Number.	Per Cent. of Total Wives.	Number.	Per Cent. of Total Wives.	Number.	Per Cent. of Total Wives.	Number.	Per Cent. of Total Wives.	Number.	Per Cent. of Total Wives.
Previous to 1700.. ..	5	1.81	11	4.00	49	17.76	139	50.36	67	24.27
1700–1749..	33	4.11	56	6.98	176	21.95	344	42.89	179	22.32
1750–1799..	98	4.98	118	6.00	531	17.01	796	40.50	386	19.63
1800–1849..	440	7.96	657	11.88	2,088	37.75	1,613	29.17	507	9.17
1850–1869..	428	13.98	625	20.41	1,275	41.64	481	15.71	72	2.36
1870–1879..	202	18.60	265	24.40	434	39.96	93	8.57	4	0.37

These statistics make it very clear that the wives of native Americans are not only remaining childless in increasingly large numbers, but that a rapidly increasing proportion are electing to bear not more than one child, two children, or three children. As a necessary corollary the number of native American wives who elect to bear large families of from six to nine children, and ten or more children, are becoming extremely rare. This summer at a boarding-house where several families were stopping, only one American mother had as many as two children. The little girl of a one-child mother innocently inquired if the mother with two children was an American.

In the period previous to 1700 1.8 or less than 2 per cent. of the wives had only one child, while in 1870 to 1879, 18.6 per cent. of the wives had only one child. On the other hand, previous to 1700, 24.3 per cent. of the wives had families of ten or more children, but by 1870 to 1879 the corresponding per cent. was only 0.37.

As a result of these most significant changes in native American families, it necessarily follows that the average number of children per wife has decreased, as is clearly shown in Table I.

The age at marriage was noted of 2,252 brides and the average age of these by chronological periods was as follows:

TABLE IV.

AGE OF BRIDES AT MARRIAGE.

Period.	Number of Brides.	Aggregate o the Ages.	Average Age at Marriage.
Previous to 1700	30	642	21.4
1700-1749	147	3,196	21.7
1750-1799	284	6,256	22.0
1800-1849	969	21,617	22.3
1850-1869	633	14,512	22.9
1870-1879	189	4,374	23.1

These figures are significant of the change that has taken place in the average age at marriage. They indicate that the American bride of today is approximately two years older, on an average, than the American bride of the seventeenth century. The increase in the average age has apparently been quite gradual throughout the period under observation. A confirmation of the increasing average age of brides is found in the Massachusetts returns over a long period of years. The decline in the birth-rate of American wives cannot, however, be explained away by this average increase in the age at marriage. Granting that the period of fecundity is limited and that two years lost is an important item, it obviously is not sufficient to account for a decline in the average number of births per wife from 7.37 to 2.77.

The statistics here brought together present an awful indictment against the morals of the Americans of today. France has long been an example to the world of the Malthusian doctrines carried to an extreme, but the United States today presents a spectacle, in this respect, which it is doubtful if France can equal. In the United States, the native stock which should take some pride in its own perpetuation is rapidly dwindling to mere nothingness, while the triumphant immigrants are submerging it by sheer force of their greater virility as revealed in their much higher birth-rates.

If the genealogical records teach anything, it is this, that unless a radical change is effected very soon, the stock which founded this nation and which nurtured it through the grave perils and trials of the formative period, will soon have vanished

from the face of the earth. Unless a radical change is soon effected the historian of no far distant period will be compelled to say that the descendants of the colonizers of the United States preferred material luxuries to spiritual realities, lustful conceits to correct theories of life, and selfish gratifications of inordinate ambitions to unselfish acceptance of the duties of parenthood. It is a very real condition and not a mere theory that now confronts the native element of the population of this republic, and Mr. Roosevelt has sounded no false alarm in his vigorous preachments against race suicide.

TABLE A.

STATISTICS OF BIRTHS COMPILED FROM TWENTY-TWO GENEALOGICAL RECORDS OF AMERICAN FAMILIES.

Number of Children per Wife.	Previous to 1700.		1700–1749.		1750–1799.		1800–1849.		1850–1869.		1870–1879.	
	Number of Wives.	Per Cent. of Total.	Number of Wives.	Per Cent. of Total.	Number of Wives.	Per Cent. of Total.	Number of Wives.	Per Cent. of Total.	Number of Wives.	Per Cent. of Total.	Number of Wives.	Per Cent. of Total.
None........	5	1.81	14	1.75	37	1.88	225	4.07	181	5.91	88	8.10
1..........	5	1.81	33	4.11	98	4.98	440	7.96	428	13.98	202	18.60
2..........	11	3.99	56	6.98	118	6.00	657	11.88	625	20.41	265	24.40
3..........	9	3.26	46	5.74	133	6.76	749	13.54	545	17.80	210	19.34
4..........	11	3.99	60	7.48	184	9.36	700	12.66	447	14.60	147	13.53
5..........	29	10.51	70	8.73	214	10.89	639	11.55	283	9.24	77	7.09
6..........	34	12.32	92	11.47	204	10.38	559	10.11	211	6.89	51	4.70
7..........	26	9.42	101	12.59	195	9.92	402	7.29	149	4 87	22	2.03
8..........	47	17.03	85	10.60	216	10.99	367	6.64	81	2.64	11	1.01
9..........	32	11.59	66	8.23	181	9.21	284	5.13	40	1.31	9	0.83
10..........	29	10.51	55	6.86	148	7.53	218	3.94	35	1.14	4	0.37
11..........	19	6.88	48	5.99	119	6.05	142	2.57	18	0.59	......	......
12..........	11	3.99	37	4.61	41	2.09	75	1.36	7	0.23	......	......
13..........	4	1.45	18	2.24	46	2.34	37	0.67	7	0.23	......	......
14..........	3	1.08	12	1.50	14	0.71	17	0.31	2	0.07	......	......
15..........	......	......	4	0.50	10	0.51	5	0.09	2	0.07	......	......
16..........	1	0.36	2	0.25	2	0.10	5	0.09	1	0.03	......	......
17..........	......	......	......	......	2	0.10	4	0.07	......	......	......	......
18..........	......	......	1	0.12	3	0.15	3	0.05	......	......	......	......
19..........	......	......	2	0.25	1	0.05	1	..0.02	......	......	......	......
Total.....	276	100.00	802	100.00	1,966	100.00	5,530	100.00	3,062	100.00	1,086	100.00

SUMMARY.

0–2........	21	7.61	108	12.84	253	12.86	1,322	23.91	1,234	40.30	555	51.10
3–5........	49	17.76	176	21.95	531	17.01	2,088	37.75	1,275	41.64	434	39.96
6–9........	139	50 36	344	42.89	796	40.50	1,613	29.17	481	15.71	93	8.57
10 and over .	67	24.27	179	22.32	386	19.63	507	9.17	72	2.36	4	0.37

TABLE B.

NUMBER OF CHILDREN PER WIFE.

STATISTICS COMPILED FROM TWENTY-TWO GENEALOGICAL RECORDS OF AMERICAN FAMILIES.

Children per Wife.	Previous to 1700.		1700–1749.		1750–1799.		1800–1849.		1850–1869.		1870–1879.	
	Number of Wives.	Aggregate Number of Children.	Number of Wives.	Aggregate Number of Children.	Number of Wives.	Aggregate Number of Children.	Number of Wives.	Aggregate Number of Children.	Number of Wives.	Aggregate Number of Children.	Number of Wives.	Aggregate Number of Children.
None........	5	0	14	0	37	0	225	0	181	0	88	0
1..........	5	5	33	33	98	98	440	440	428	428	202	202
2..........	11	22	56	112	118	236	657	1,314	625	1,250	265	530
3..........	9	27	46	138	133	399	749	2,247	545	1,635	210	630
4..........	11	44	60	240	184	536	700	2,800	447	1,788	147	588
5..........	29	145	70	350	214	1,070	639	3,195	283	1,415	77	385
6..........	34	204	92	552	204	1,224	559	3,354	211	1,266	51	306
7..........	26	182	101	707	195	1,365	403	2,821	149	1,043	22	154
8..........	47	376	85	680	216	1,728	367	2,936	81	648	11	88
9..........	32	288	66	594	181	1,629	284	2,556	40	360	9	81
10..........	29	290	55	550	148	1,480	218	2,180	35	350	4	40
11..........	19	209	48	528	119	1,309	142	1,562	18	198	......	......
12..........	11	132	37	444	41	492	75	900	7	84	......	......
13..........	4	52	18	234	46	598	37	481	7	91	......	......
14..........	3	42	12	168	14	196	17	238	2	28	......	......
15..........	......	......	4	60	10	150	5	75	2	30	......	......
16..........	1	16	2	32	2	32	5	80	1	16	......	......
17..........	......	......	......	......	2	34	4	68	......	......	......	......
18..........	......	......	1	18	3	54	3	54	......	......	......	......
19..........	......	......	2	38	1	19	1	19	......	......	......	......
Total.....	276	2,034	802	5,478	1,966	12,649	5,530	27,320	3,062	10,630	1,086	3,004
Average number of children per wife......	7.37		6.83		6.43		4.94		3.47		2.77	

IMMIGRATION AS A SOURCE OF URBAN INCREASE.

By F. Stuart Chapin, Ph. D., *Assistant Professor of Sociology and Economics, Smith College.*

There are no direct records of the composition of urban increase in the United States for the last two census decades, hence resort must be had to an indirect method of estimating the composition of urban growth. Professor John M. Gillette estimated in 1911 that from 65 to 70 per cent. of the urban growth of the United States in recent years was composed of immigrants.* The present paper is an effort to determine the contribution to the growth of cities in the United States made by immigration during the period 1890 to 1913.

It will be seen from Table I, that the total immigration to the United States during the decade 1890–1900 was equivalent to a large proportion of the urban increase (considering only places of 8,000 inhabitants and over as urban) for the same period; that the total immigration to the United States during the decade 1900–1910 was actually greater than the total urban increase for the same period; and that the total immigration 1910–1913 was equivalent to a large proportion of the estimated urban increase for the same period.

Now the immigration of recent years is localized to a marked degree. Table I shows that during the decades 1890–1900, 1900–1910, and the period 1910–1913, 75 per cent., 77.2 per cent., and 79.3 per cent., respectively, of the immigration to this country was destined to the nine states California, Connecticut, Illinois, Massachusetts, Michigan, New Jersey, New York, Ohio, and Pennsylvania. Since 1895 the Commissioner Generals of Immigration, and for the years 1892–1894 the Superintendents of Immigration, have recorded every year the number of immigrants destined to each state and territory. The immigration to these nine states for the year 1891 was estimated on the assumption that it was approximately equivalent to the average immigration for the period 1892–1900. But in dealing with these statistics of immigration the Commissioner warns us, "It should be borne in mind that

*Drift to the City in Relation to the Rural Problem, Amer. Jour. of Sociology, Vol. 16, p. 645.

neither the information in regard to occupations, nor that giving destinations is conclusive of the facts stated. The destination is taken from the avowed purposes of the aliens upon that point, which, if true, are subject to change."*

An examination of the distribution of the population of these states shows that in 1890, 1900, and 1910 the urban population formed respectively 66.4 per cent., 67.4 per cent., and 63.7 per cent. of the urban population of the country (see Table II). Individually, these states are highly urbanized communities, for in 1890, 1900, and 1910 their average urban population formed respectively, 45.8 per cent., 51.6 per cent., and 59.9 per cent. of their populations. Moreover, these averages are decidedly higher than the percentage urban population of the United States as a whole, which was 29 per cent., 32.9 per cent., and 38.8 per cent. for the same dates.

In composition, the populations of these states averaged over 50 per cent. of foreign birth and parentage in 1900 and 1910. The percentages of the population of the great cities of these states which are of foreign birth and parentage are considerably higher than in the states at large. For example, in the cities of New York, Chicago, Boston, Cleveland, Bridgeport, Worcester, Fall River, Detroit, Buffalo, and Paterson, the population of foreign birth and parentage ranges from 70.7 per cent. in Worcester, to 86 per cent. of the population in Fall River.

A comparison of the urban increase of these nine states with the urban increase for the country for the decades 1890–1900 and 1900–1910, reveals the fact that the urban increase of these nine states formed respectively 70.1 per cent. and 63.6 per cent. of the total urban increase of the country during the decades named. In the decade 1890–1900, the immigration to these states was equivalent to 58.4 per cent. of their urban gain for the same decade. In the decade 1900–1910, the immigration to these states was actually very much greater than their urban gain. But it must be noted that these totals do not take account of the number of aliens who have left the nine states during the same period. Since 1908, the Commissioner has recorded annually the number of aliens leaving each state.

* Annual report of 1906, p. 14.

If we deduct this number from the number of immigrants destined to these states, we have the net immigration to these states—the permanent gain from immigration. Proceeding in this manner, we find that the net immigration to these states for the period 1908 to 1913, is 69.9 per cent. of the total immigration for the same period. Thus about 70 per cent. of the immigration appears to be permanent gain.

But the problem of estimating the net immigration to these states for the decades 1890–1900 and 1900–1910, now arises. Is it permissible to apply this percentage obtained from the short period 1908 to 1913, to the decades 1890–1900 and 1900–1910? We shall not attempt to apply this percentage to the decade 1890–1900, chiefly for the reason that the recent immigration has shown itself to be more migratory than that of the earlier period and our correction percentage, even if we could get it, would probably be much smaller. Since all we can hope for from the application of this indirect method of estimating the composition of urban increase is approximately correct results, it seems best to accept the percentage 58.4 for the earlier decade as being fairly accurate.

With reference to the decade 1900–1910, we may assume that the percentage obtained from the period 1908 to 1913 applies. This assumption has at least the advantage of conservatism, *i. e.*, of making the net immigration appear smaller than it really is, because general considerations lead us to believe that the migratory and shifting elements in the recent immigration were much less numerous prior to 1907 and particularly in the early years of the decade. For it must be remembered that during the years immediately prior to 1907 and subsequently, the proportion of immigrants from Southern and Eastern Europe has increased considerably, and it is just this alien element which has added to the migratory and shifting character of our foreign population. If, therefore, we assume that 70 per cent. of the immigration to the nine states in the decade 1900–1910 was approximately clear gain, then the 5,001,295 aliens so added to the population of these states are equivalent to 85.2 per cent. of the urban gain for that decade. Similarly, the net immigration to these states for the period 1910–1913 is equivalent to 64.1 per cent. to the estimated urban increase.

Inasmuch as immigration appears to have been the preponderating source of urban increase in those nine highly urbanized states which contain a majority of the urban population of the country, it is permissible to conclude that immigration has been the chief source of urban increase in the United States during the past quarter of a century.

TABLE I.

COMPARISON OF URBAN GAINS AND IMMIGRATION 1890-1913.

State.	Urban Gain, Periods.		
	1890-1900.	1900-1910.	1910-1913.*
California	154,612	558,802	281,285
Connecticut	108,589	181,122	76,447
Illinois	785,995	696,432	306,492
Massachusetts	567,692	514,404	221,624
Michigan	201,239	321,326	146,492
New Jersey	372,089	463,659	196,257
New York	1,380,165	1,759,939	747,923
Ohio	440,498	584,260	270,947
Pennsylvania	713,886	786,264	278,557
Total	4,724,765	5,866,208	2,526,004
Total for U. S.	6,736,095	9,227,030	3,958,253
Per cent. urban gain in 9 states is of urban gain of U. S.	70.1	63.6	63.8
Immigration and Urban Gain.	**1890-1900.**	**1900-1910.**	**1910-1913.**
Immigration to nine states	2,768,659	7,144,702	2,313,570
Immigration to United States	3,687,564	9,243,958	2,914,651
Per cent. immigration to nine states is of immigration to United States	75.0	77.2	79.3
Per cent. immigration to nine states is of urban gain	58.4	85.2†	64.1†

* Estimated, Census Bulletin No. 122.

† Based on net immigration given in Reports of Commissioner General of Immigration 1908-1913 and computed for period 1900-1910. Total immigration to nine states 1908-1913 was 4,343,532, net 3,024,815. Net immigration 1910-1913 was 1,619,499, estimated for 1900-1910 at 5,001,295, this is 85.2 per cent. of urban gain for same period (see above).

TABLE II.

URBAN POPULATION (PLACES OF 8,000 INHABITANTS AND OVER).

State.	Urban Population.			Per Cent. Urban.		
	1890.	1900.	1910.	1890.	1900.	1910.
California	495,086	649,474	1,275,359	40.8	43.7	53.6
Connecticut	376,479	483,069	805,992	50.4	53.2	72.3
Illinois	1,485,955	2,271,940	3,049,443	38.8	47.1	54.0
Massachusetts	1,564,931	2,132,623	2,748,518	69.9	76.0	81.6
Michigan	546,095	747,334	1,123,558	26.1	30.9	39.5
New Jersey	780,912	1;153,001	1,672,922	54.0	61.2	65.5
New York	3,599,877	4,980,042	6,817,433	60.0	68.5	73.1
Ohio	1,159,342	1,599,840	2,279,449	31.6	38.5	49.9
Pennsylvania	2,152,051	2,865,937	3,828,482	40.9	45.5	49.9
Total and averages	12,160,628	16,885,393	22,751,601	45.8	51.6	59.9
For U. S. totals and Averages	18,295,410	25,031,505	35,724,432	29.0	32.9	38.8
Per cent. urban population of nine states is of total urban population of United States				66.4	67.4	63.7

AMERICAN LIFE TABLES.

By C. H. Forsyth, *Ann Arbor, Mich.*

The purpose of this paper is to present the first mortality tables ever constructed in this country, based on population data and mortality statistics covering as many as ten years. The methods used in their construction is also briefly explained.

Three mortality tables are given: one for the males, one for the females, and one for males and females combined, and all are based on data covering the decade 1901–1910.

The decade 1901–1910 represents the first period in which mortality statistics were collected and published annually by the government, previous reports having been made decennially. Other countries—such as England, Germany and France—have not only been collecting and publishing mortality statistics annually for many decades but have constructed appropriate mortality tables exhibiting the death-rates, expectations of life, etc., at each age. This country is far behind the most prominent countries in this respect, less than half of the total number of the states being compelled at present to keep any accurate record of deaths.

However, the work of the government in the collection of mortality statistics is exceedingly worthy of commendation considering how recent the main part of the work was begun (1880) and the strides made in those years, particularly the last decade.

The data used in this paper were collected from those states whose records are considered sufficiently accurate by the government to be designated formally as registration states.* These registration states, together with about one hundred and fifty cities in non-registration states, comprise the so-called registration area proper.

In 1900 the registration states included Connecticut, Indiana, Maine, Massachusetts, Michigan, New Hampshire, New Jersey, New York, Rhode Island, Vermont, and the District of Columbia. In 1906 there were added the states California, Colorado, Maryland, Pennsylvania, and South

* See Bulletin 104, Mortality Statistics, 1908, p. 7.

Dakota, although South Dakota's report was rejected in 1910. Washington and Wisconsin were added in 1908, Ohio in 1909, and Minnesota, Montana, and Utah in 1910.

As the population data are collected only once in each ten years, they were assumed to change from year to year by a constant difference.

It was taken into consideration that the census for 1900 was taken as of June 1 and that for 1910 as of April 15. For example, the population at June 1, 1901, was taken as the population at June 1, 1900, plus 6-79 of the difference between the populations at June 1, 1900 and April 15, 1910.

The population at January 1 for any year was found by adding to the population at June 1 (or April 15) 5-12 (or 7-24) of the deaths for that year, on the assumption that deaths take place uniformly throughout the year.

The total data used covered not only the eleven original registration states (as of 1900) but all that became registration states during the decade 1901–1910. Thus twenty-two states were included. North Carolina was not included because the appropriate population data were not available by ages (being wholly urban).

The mortality statistics are given in quinquennial age groups, except at the earlier ages from 0 to 4 inclusive, at which the deaths are given for each age.

The population data are given in quinquennial age groups except at the higher ages beginning with age 65 at which the data are given in decennial age groups.

The decennial age groups were broken up into quinquennial age groups by ordinary third differences and the quinquennial age groups, both for population and mortality data, were broken up into data for each age by first forming columns of T_x from each set of data, where T_x represents the number (deaths or population) at age x and all higher ages, and interpolating the four intervening values for each group—except, of course, the two at each end—by Sprague's Osculatory method.* This method cannot be explained here, as space will not permit. We merely state that the method has the advantage over the use of ordinary fifth differences in that

* The Record, American Institute of Actuaries, Vol. I, No. 3, June, 1911, p. 9.

the curvature as well as the slope of the curve, representing the values under discussion, is considered, with the result that the curve, which would otherwise be somewhat "undulating," becomes very smooth throughout.

The two quinquennial age groups at each end were interpolated by ordinary third differences (taken centrally in the case of the inner groups).

The first quinquennial age group of the population data, however, was an exception, because use was made of the population as given for those at the age of birth. The values used as a basis for interpolation being no longer equidistant—as is necessary in the use of ordinarry differences—La Grange's interpolation formula was used to obtain the population at ages 2, 3, and 4.

The work of constructing mortality tables (such as are presented in this paper) would be much easier if the census would include tables of populations for the different divisions of the registration area as given in the mortality statistics, this area being the only area of any value for such purposes. The conflicting definitions of "urban" and "rural" population used by the census and in the mortality statistics is also unfortunate and could be easily remedied.

The death-rates in the neighborhood of age 90 are doubtlessly so unreliable that refined methods of extending the tables beyond that age are not worth while. However, for the purpose of computing the expectation of life (a function little affected by choice of methods of terminating the mortality tables) for each age, the tables were completed by using ordinary third differences, as applied to the death-rates at ages 70, 75, 80 and 85, to estimate the death-rates at higher quinquennial ages. The intervening death-rates were interpolated by Sprague's method mentioned above.

In conclusion, tables are given comparing the death-rates and expectations of life at representative ages of the American mortality tables, presented in this paper, with those of similar tables constructed in England and Wales,* and the German Empire.* However, it must be kept in mind that the latter

* Sixty-fifth Annual Report of the Registrar-General. Supplement 1891–1900, Part I, p. xlii.

* Deutsche Sterbetafeln 1891–1900. Band 200, Seite 2.

tables are based on data covering the decade 1891–1900 while the American tables refer to the decade 1901–1910.

The English and German death-rates exceed the American rates everywhere except in the neighborhood of ages 10 and 20, and even here there is no essential difference. The American death-rates are relatively very low at the age of birth, the German rates seeming very excessive.

As might be expected, on considering the table of representative death-rates, the American expectations of life far exceed those of England and Wales, and the German Empire, the average length of life in America being about 50 years, compared with about 46 years in England and Wales, and about 42 years in the German Empire. Of course, a comparison of tables all covering the same decade, such as 1901–1910, would not show results so much in favor of American conditions, but there can be no doubt that there is an actual advantage which is considerable. This advantage seems natural and there appears no reason why it can not be maintained. In our minds, no one thing would conduce more to this end than to identify as soon as possible the whole of the United States with the registration area. In fact, to have a single state—not to speak of over half of the union—in which no accurate record of deaths is required, should be regarded as a national disgrace.

MALES.

Age.	l_x.	d_x.	q_x.	$\mathring{e}_x$.	Age.	l_x.	d_x.	q_x.	$\mathring{e}_x$.
0	1000000	142420	.14243	48.34	50	576439	9079	.01575	20.59
1	857570	26310	3068	55.15	51	567360	9282	1636	19.94
2	831260	11579	1393	55.94	52	558078	9554	1712	19.25
3	819681	7180	876	55.70	53	548524	9956	1815	18.56
4	812501	5363	660	55.22	54	538568	10486	1947	17.86
5	807138	3971	.00492	54.27	55	528082	11063	.02095	17.22
6	803167	3438	428	53.93	56	517019	11736	2270	16.59
7	799729	2983	373	53.13	57	505283	12425	2459	15.97
8	796746	2605	327	52.33	58	492858	13002	2638	15.36
9	794141	2311	291	51.53	59	479856	13455	2804	14.75
10	791830	2122	.00268	50.66	60	466401	13908	.02982	14.16
11	789708	2006	254	49.79	61	452493	14308	3162	13.60
12	787702	1993	253	48.92	62	438185	14762	3369	13.04
13	785709	2059	262	48.03	63	423423	15379	3632	12.47
14	783650	2218	283	47.16	64	408044	16134	3954	11.89
15	781432	2657	.00340	46.34	65	391910	16860	.04302	11.36
16	778775	2998	385	45.46	66	375050	17612	4696	10.78
17	775777	3336	430	44.63	67	357438	18183	5087	10.36
18	772441	3646	472	43.86	68	339255	18377	5417	9.89
19	768795	3915	509	43.08	69	320878	18284	5698	9.43
20	764882	4184	.00547	42.25	70	302594	18141	.05995	8.97
21	760698	4465	587	41.48	71	284453	17869	6282	8.51
22	756233	4674	618	40.74	72	266584	17707	6642	8.05
23	751559	4780	636	39.96	73	248877	17810	7156	7.58
24	746779	4832	647	39.22	74	231067	18090	7829	7.12
25	741947	4786	.00645	38.48	75	212977	18254	.08571	6.69
26	737161	4909	666	37.74	76	194723	18360	9429	6.27
27	732252	5031	687	36.98	77	176363	18299	10376	5.87
28	727221	5156	709	36.24	78	158064	17978	11374	5.49
29	722065	5286	732	35.49	79	140086	17452	12458	5.13
30	716779	5405	.00754	34.75	80	122634	16973	.13840	4.79
31	711374	5791	814	34.01	81	105661	16615	15725	4.48
32	705583	5659	802	33.28	82	89046	15785	17726	4.22
33	699924	6723	833	32.55	83	73261	14065	19198	4.02
34	693201	6010	867	31.86	84	59196	11795	19925	3.86
35	687191	6192	.00901	31.14	85	47401	9099	.19196	3.70
36	680999	6374	936	30.41	86	38302	7786	20328	3.46
37	674625	6537	969	29.71	87	30516	66231	21705	3.21
38	668088	6661	997	28.98	88	23893	5595	23416	2.97
39	661427	6773	1024	28.28	89	18298	4682	25588	2.73
40	654654	6894	.01053	27.55	90	13616	3867	.28403	2.48
41	647760	7022	1084	26.85	91	9749	3026	31036	2.27
42	640738	7176	1120	26.13	92	6723	2286	34002	2.07
43	633562	7387	1166	25.42	93	4437	1656	37333	1.87
44	626175	7633	1219	24.72	94	2781	1142	41057	1.69
45	618542	7899	.01277	24.02	95	1639	741	.45205	1.52
46	610643	8189	1341	23.32	96	898	447	49807	1.36
47	602454	8458	1404	22.63	97	451	248	54893	1.21
48	593996	8684	1462	21.95	98	203	123	60493	1.07
49	585312	8873	1516	21.27	99	80	53	66638	.94
					100	27	20	.73356	.80
					101	7	6	80678	.64
					102	1	1	88635	.50
					103	0			

FEMALES.

Age.	l_x.	d_x.	q_x.	$\mathring{e}_x$.	Age.	l_x.	d_x.	q_x.	$\mathring{e}_x$.
0	1000000	116380	.11638	51.92	50	627304	8029	.01280	21.95
1	883620	24803	2807	57.69	51	619275	8348	1348	21.22
2	858817	9859	1148	58.34	52	610927	8706	1425	20 50
3	848958	8074	951	58.02	53	602221	9124	1515	19.79
4	840884	5205	619	57 57	54	593097	9626	1623	19.09
5	835679	3886	.00465	56.86	55	583471	10193	.01747	18.40
6	831793	3352	403	56.18	56	573278	10829	1889	17.71
7	828441	2908	351	55.41	57	562449	11513	2047	17.05
8	825533	2534	307	54.61	58	550936	12154	2206	16.39
9	822999	2255	274	53.76	59	538782	12731	2363	15.75
10	820744	2118	.00258	52.92	60	526051	13309	.02530	15.12
11	818626	1981	242	52.05	61	512742	13824	2696	14.50
12	816645	1935	237	51.18	62	498918	14389	2884	13.89
13	814710	1996	245	50.29	63	484529	15093	3115	13.29
14	812714	2137	263	49.42	64	469436	15919	3391	12.69
15	810577	2578	.00318	48.55	65	453517	16721	.03687	12.12
16	807999	2917	361	47.71	66	436796	17520	4011	11.57
17	805082	3228	401	46.88	67	419276	18251	4353	11.03
18	801854	3488	435	46.05	68	401025	18828	4695	10.51
19	798366	3696	463	45.26	69	382197	19270	5042	10.00
20	794670	3918	.00493	44.46	70	362927	19682	.05423	9.51
21	790752	4144	524	43.67	71	343245	20001	5827	9.03
22	786608	4318	549	42.91	72	323244	20248	6264	8.55
23	782290	4475	571	42.10	73	302996	20434	6744	8.09
24	777815	4574	588	41 39	74	282562	20554	7274	7.64
25	773241	4678	.00605	40.63	75	262008	20560	.07847	7.20
26	768563	4788	623	39.88	76	241448	20414	8455	6.77
27	763775	4881	639	39 12	77	221034	20253	9163	6.35
28	758894	4971	655	38.38	78	200781	20174	10048	5.93
29	753923	5051	670	37.62	79	180607	20158	11161	5.55
30	748872	5130	.00685	36.86	80	160449	20127	.12544	5.18
31	743742	5206	700	36.11	81	140322	20264	14441	4.85
32	738536	5288	716	35.37	82	120058	19732	16435	4.58
33	733248	5375	733	34.62	83	100326	17822	17764	4.39
34	727873	5466	751	33.88	84	82504	15054	18246	4.23
35	722407	5555	.00769	33.13	85	67450	11827	.17534	4.06
36	716852	5642	787	32.38	86	55623	10280	18481	3.81
37	711210	5718	804	31.63	87	45343	8896	19620	3.57
38	705492	5778	819	30.88	88	36447	7665	21031	3.31
39	699714	5836	834	30.13	89	28782	6573	22838	3.06
40	693878	5898	.00850	29.38	90	22209	5619	.25300	2 82
41	687980	5979	869	28.63	91	16590	4547	27405	2.61
42	682001	6090	893	27.87	92	12043	3582	29740	2.40
43	675911	6252	925	27.13	93	8461	2735	32325	2.20
44	669659	6449	963	26.36	94	5726	2014	35180	2.02
45	663210	6665	.01005	25.63	95	3712	1423	.38325	1.84
46	656545	6907	1052	24.88	96	2289	956	41780	1.68
47	649638	7166	1103	24.14	97	1333	607	45564	1.52
48	642472	7440	1158	23.41	98	726	361	49697	1.37
49	635032	7728	1217	22.67	99	365	198	54200	1.23
					100	167	99	.59092	1.10
					101	68	44	64393	.99
					102	24	17	70123	.88
					103	7	5	76301	.79
					104	2	2	82948	.50
					105	0			

MALES AND FEMALES, COMBINED.

Age.	l_x	d_x	q_x	$\overset{\circ}{e}_x$	Age.	l_x.	d_x	q_x	$\overset{\circ}{e}_x$
0	1000000	129630	12963	50 08	[illegible]	601198	8616	.01433	21 25
1	870370	25580	2939	56 49	51	592583	8877	1498	20 53
2	844790	10687	1265	57 14	52	583706	9193	1575	19 84
3	834103	7590	910	56 88	53	574513	9600	1671	19 15
4	826513	5290	640	56 37	54	564913	10118	1791	18 48
5	821223	3934	00479	55 77	55	554795	10691	01927	17 80
6	817289	3400	416	55 05	56	544104	11345	2085	17 15
7	813889	2946	362	54 26	57	532759	12030	2258	16 50
8	810943	2571	317	53 45	58	520729	12633	2426	15 86
9	80 372	2288	283	52 64	59	508096	13144	2587	15 25
10	806084	2120	00263	51 77	60	494952	13656	02759	14 66
11	803964	1994	248	50 90	61	481296	14107	2931	14 08
12	801970	1965	245	50 01	62	467189	14614	3128	13 47
13	800005	2024	253	49 15	63	452575	15270	3374	12 88
14	797981	2178	273	48 27	64	437305	15765	3605	12 32
15	795803	2618	00329	47 39	65	421540	16828	03991	11 75
16	793185	2959	373	46 57	66	404712	17597	4348	11 21
17	790226	3287	416	45 74	67	387115	18241	4712	10 71
18	786939	3565	453	44 91	68	368874	18624	5049	10 20
19	783374	3799	485	44 15	69	350250	18787	5364	9 73
20	779575	4054	00520	43 31	70	331463	18913	05706	[illegible]
21	775521	4304	555	42 53	71	312550	18919	6053	8 76
22	771217	4504	584	41 81	72	293631	18948	6453	8 30
23	766713	4623	603	41 03	73	274683	19088	6949	7 84
24	762090	4702	617	40 29	74	255595	19292	7548	7 39
25	757388	4741	00626	39 55	75	236303	19379	08201	6 97
26	752647	4855	645	38 76	76	216924	19358	8924	[illegible]
27	747792	4965	664	38 02	77	197566	19243	9740	6 19
28	742827	5066	682	37 28	78	178323	19036	10675	5 75
29	737761	5179	702	36 52	79	159287	18754	11774	5 36
30	732582	5282	00721	35 78	80	140533	18487	13155	5 00
31	727300	5520	759	35 06	81	122046	18361	15044	4 70
32	721780	5486	760	34 29	82	103685	17666	17038	4 43
33	716294	5623	785	33 58	83	86019	15850	18426	4 25
34	710671	5764	811	32 81	84	70169	[illegible]	19010	[illegible]
35	704907	5900	00837	32 08	85	56830	10388	18279	3 94
36	699007	6039	864	31 36	86	46442	8961	19295	3 72
37	692968	6160	889	30 63	87	37481	7692	20522	3 48
38	686808	6257	911	29 88	88	29789	6566	22042	3 25
39	680551	6350	933	29 15	89	23223	5568	23977	3 03
40	674201	6445	00956	28 45	90	17655	4686	26555	2 81
41	667756	6551	981	27 69	91	12969	3642	28551	2 65
42	661205	6691	1012	26 97	92	9327	2030	31416	2 30
43	654514	6879	1051	26 22	93	7297	2501	34274	2 06
44	647635	7105	1097	25 50	94	4796	1796	37449	1 88
45	640530	7347	01147	24 77	95	3000	1229	40965	1 71
46	633183	7611	1202	24 06	96	1771	794	44945	1 54
47	625572	7882	1260	23 35	97	977	480	49114	1 39
48	617690	8129	1316	22 64	98	497	267	53796	1 25
49	609561	8363	1372	21 93	99	230	185	58913	1 11
					[illegible]	85	61	64491	96
					101	34	24	70553	85
					102	10	8	77122	70
					103	2	2	84223	50
					104	0			

DEATH-RATES.*

Age.	Males.			Females.			Males and Females.	
	English.	German.	American.	English.	German.	American.	German.	American.
0.....	.17186	.23386	.14243	.14066	.19862	.11638	.21670	.12963
10.....	.00214	.00304	.00268	.00231	.00322	.00258	.00313	.00263
20.....	.00457	.00507	.00547	.00414	.00459	.00493	.00518	.00520
30.....	.00671	.00655	.00754	.00618	.00696	.00685	.00676	.00721
40.....	.01190	.01094	.01053	.00995	.00901	.00850	.00995	.00956
50.....	.01936	.01860	.01575	.01495	.01288	.01280	.01560	.01433
60.....	.03506	.03395	.02982	.02928	.02751	.02530	.03051	.02759
70.....	.07212	.07342	.05995	.06243	.06786	.05423	.07038	.05706
80.....	.15200	.16384	.13840	.13626	.15575	.12544	.15983	.13155
90.....	.29186	.33597	.28403	.26378	.30239	.25300	.31551	.26555

EXPECTATIONS OF LIFE.*

Age.	Males.			Females.			Males and Females.	
	English.	German.	American.	English.	German.	American.	German.	American.
0.....	44.13	40.56	48.34	47.77	43.97	51.92	42.23	50.08
1.....	52.22	51.85	55.15	54.53	53.79	57.69	52.83	56.49
10.....	49.03	49.66	50.66	51.97	51.71	52.92	50.70	51.77
20.....	41.02	41.23	42.25	43.44	43.37	44.46	42.32	43.31
30.....	33.07	33.46	34.75	35.39	35.63	36.86	34.56	35.76
40.....	25.64	25.89	27.55	27.82	28.15	29.38	27.04	28.45
50.....	18.90	19.00	20.59	20.64	20.58	21.95	19.82	21.25
60.....	12.93	12.82	14.16	14.10	13.60	15.12	13.24	14.65
70.....	8.05	7.77	8.97	8.78	8.11	9.51	7.95	9.26
80.....	4.62	4.24	4.79	5.05	4.49	5.18	4.38	5.00
90.....	2.58	2.32	2.48	2.87	2.66	2.82	2.52	2.81

*The English and German tables are based upon the decade 1891–1900, while the American table is based upon the decade 1901–1910.

SERVICE INCOME AND PROPERTY INCOME.

By Scott Nearing, *Wharton School, University of Pennsylvania.*

Service *vs.* Property Ownership.

Heretofore, political economy has been content to discuss income under the heading of rent, interest, profits, and wages. The situation in the United States cannot be analyzed as it was by the English economists, since there is no American landlord class, and therefore no capitalist class distinct from the landlord class. Agricultural land, for the most part, is owned by individual farmers, or by persons of moderate means. The natural resources and the industries of the country are owned and capitalized through the corporate system of business organization. In England there is still a landlord who owns the coal lands, and a capitalist who develops them; in the United States, the natural resources are, for the most part, owned and developed by the same industrial group.

A classification loses virility whenever it becomes a mere abstraction. That classification only possesses real vitality which has some specific bearing on the conditions that it aims to describe. An appeal to the present income facts in the United States will alone provide a classification of income which will be really applicable to the conditions now prevailing.

Theories aside, an appeal to the world of affairs shows that the current industrial facts in the United States make the logical income distinction one between that income which is the product of effort, and that income which is the product of property ownership. The individual whose effort creates values for which society pays, receives service income. The individual who secures a return because of his property ownership receives a property income.

The importance of the contrast between service and property income is represented not by the fact that it will separate the working class from the leisure class, but that it will lay the basis for the elimination of exploitation, on the one hand,

and of economic parasitism, on the other hand. Economic salvation does not lie through class conflict, but through distinctions which will pay the worker the full value of his work, and drive the idler out of society.

The Basic Income Question.

The basic income question is one, not of theory, but of fact. Marginal acres, marginal dollars of capital, and marginal laborers may be figments of the economic imagination, or they may be symbols of a real economic distinction. In the city of Omaha or of Portland, in the factories of Brockton, in the sweatshops of Pittsburgh and New York, in the mines of West Virginia and Colorado, the marginal man is missing. In his place there appear great industrial enterprises which are engaged in the production of economic goods of a certain value. For these goods, or these values, the forces of the community contend. In that production and in that contention lies the real problem of distribution.

The matter may be made still more concrete. An industry —steel-making, for example—takes raw materials, and by the process of manufacture adds to them value equivalent to one hundred dollars. What part of that hundred dollars goes in wages and salaries to the workers in the industry? What part of it goes in interest and dividends to the owners of the stocks and bonds? The former receive service income; the latter, property income. What proportion of the values goes in either direction?

The income question, thus boldly stated, cannot be answered with absolute accuracy. Up to the present time, most industries have failed to issue public reports which permit of a full income analysis. In the very near future public bodies, such as the Interstate Commerce Commission, the public utilities and railroad commissions, and other similarly organized tribunals, will secure and compile this information. For the time being, almost the only authentic facts are those which have been collected and presented by the Interstate Commerce Commission, and by a few of the State public utilities commissions.

The compilation of income facts is a stupendous task, far beyond the energies of any one individual. The task will never be successfully completed until the government takes it in hand. Meanwhile, an individual, using the facts available, may point to the sharp distinction existing between income from services and income from property.

Many enthusiasts have hoped that when the facts were compiled there would appear some off-hand answer regarding the proportion of industrial income which was paid for services, and the proportion that was paid for property ownership. "Half and half," cries the agitator. "Sixty per cent. for wages, and 40 per cent. for dividends," vociferates his more conservative confrere. The most cursory study of the available facts reveals the groundlessness of this hope, and the fallacious nature of such assertions. When all of the income facts are analyzed, classified, and compiled, some government expert will be able to announce that of the total values created in the manufacturing industries, a given percentage goes for services, and another given percentage for property ownership. At the present time, however, the knowledge is but fragmentary. The proportions vary from industry to industry, and from establishment to establishment. Even at the present time, however. for a given group of establishments, and for certain industries, facts are available which show accurately what amount of the values produced in that segment of the industrial process goes for services, and what amount goes for property ownership. A long step toward an authentication of this general position is taken by Dr. Streightoff. Although he makes his statement incidentally, placing it in a footnote, he finds that reliable information is obtainable from official sources showing the apportionment of service and of property income in several large industries. Dr. Streightoff's note is as follows:

"Dr. Spahr, in his 'Essay on the Present Distribution of Wealth in the United States' (pp. 88–92, 120), has concluded that in Basel, France, Saxony, the United Kingdom, and the United States, 40 per cent. of the national incomes goes to capital, and 60 per cent. to labor. Recent available figures for eight large American industries, employing over

three million laborers, give to capital a return in dividends and interest of $1,276,419,050, and to labor in salaries and wages of $2,031,402,210, a total income of $3,307,821,260, of which the share of labor is 61 per cent., and that of capital 39 per cent. That these figures are typical of the whole field of American industry is questionable." *

TABLE I.

RETURNS OF CAPITAL AND LABOR IN EIGHT INDUSTRIES.

Industries.	Year.	Outstanding Capital Stock and Bonds.	Interest and Dividends.	Wages and Salaries.	Number of Employees.
Telegraphs	1902	$162,946,252	$8,206,975	$15,080,673	27,627
Telephones	1907	1,072,805,93	36,049,779	68,270,127	144,169
Express companies	1910	105,523,300	33,564,411	39,491,082	79,284
Central electric light and power stations	1907	1,341,995,182	46,142,902	31,935,309	42,066
Street and electric railways	1907	3,774,772,096	125,954,062	150,991,099	221,429
Incorporated mines and quarries	1902	3,217,719,458	86,020,837	354,079,476	528,720
185 Industrial combinations	1900	3,093,095,868	135,126,612	227,861,188	424,686
Steam railways	1910	18,417,132,238	805,353,472	1,143,725,306	1,699,420
Totals		$31,185,990,660	$1,276,419,050	$2,031,402,210	3,167,401

An examination of Streightoff's table shows several noteworthy facts. In the first place, all of the data relate to the decade 1900 to 1910. In the second place, six of the eight groups of industries are ordinarliy described as "public utilities." In the third place, the ratio between property income (interest and dividends) and service income (wages and salaries) is far from being a constant factor. For the eight groups of industries the ratio between property income and service income is four to six. Electric light and power stations give an opposite ratio of nine to six, while the industrial combinations report a ratio of one to four. The really interesting thing about the table is the fact that in 1912 an investigator was able to find eight groups of industries having a combined capitalization of thirty billions of dollars, all of which reported property income as distinct from service income.

The reason for the clarity of these reports as regards the distinction between property and service income lies ready

* "The Distribution of Incomes in the United States," F. H. Streightoff, New York, Columbia University Press, 1912, pp. 44, 45.

at hand. The public, in recent years, has showed a keen interest in property income. The predatory activities of certain corporations, together with the commonly accepted opinion that certain great businesses had "struck it rich," led to the appointment of commissions and other inquisitorial bodies, who were charged with this, among other duties, to find out how much these great enterprisers were making. The result of this public demand may be viewed in any library where State and Federal reports are on view.

Many accounts are so kept at the present time, either because business reasons demand it, or because government officials insist upon it, that the amounts paid for property and for service income may be readily ascertained. Such accounts must provide the basis for a study of the present-day income facts. The present study* purports to carry forward, if only for a few steps, the lines of income investigation which have been started by Hobson, Cannan, Spahr, Streightoff, and the other economists who are interested in income facts.

THE ANSWER FOR TRANSPORTATION AGENCIES.

Among all of the highly organized businesses, none are more highly organized than the transportation agencies, particularly the railroads. The pioneer work in railroading once completed, railroad managers were enabled to turn their attention to the problems of organization and administration. The result of their activities is a marvelously wrought business system which has been investigated, rounded out, and standardized by public authorities. For no group of industries is the information regarding property and service income so complete as it is for the railroads.

The problem may be stated in these general terms. A hundred dollars of value is created by an industry. Of this hundred dollars, how many dollars go in the form of service

* Throughout this study, the figures used are for 1909, 1910, and 1911, years which were arbitrarily necessitated by the availability of the figures. The census returns of the Thirteenth Census are for 1909. Most of the railroad and public utilities commissions are at least two years behind the calendar in the issue of reports. If the various groups of figures were to be at all comparable, they should be selected with some reference to the census year. Furthermore, the years 1910 and 1911 seemed fairly representative of normal business conditions. All of these reasons led to the use of data for 1910 and 1911 whenever it was available. In a few special cases 1912 data were used. These cases are, however, exceptional.

income, and how many dollars go in the form of property income? The answer will obviously vary with the character of the industry, so that an answer for railroads is not in any sense an answer for other industries. Neither will an answer for an entire industry hold good for individual railroads. The amount of income paid, particularly in the form of property income, must vary with the success of each separate business, and with the local conditions surrounding its operations.

The reader will remember that the railroad is a business involving a particularly heavy original outlay. The roadbed, terminals, rolling stock, the rights of way, and other initial charges on railroad construction are immense. Once made, these capital investments are unusually permanent. The process of making, however, involves a very heavy outlay. In 1911, railroad operations brought the railroads of the United States a revenue of $2,789,761,669. From other sources, such as rent credits, income received on the stocks, and bonds of companies under their control, and similar miscellaneous sources, the income was $77,815,345.* The total income of the railroads from all sources therefore was a little more than two and three quarters billions of dollars. During the same year, the total amount paid in wages and salaries was $1,208,466,470,† while the entire amount paid in the form of interest was $406,609,204, and the amount of dividends was $291,497,164, making the total of $698,106,368 paid out in the form of income for railroad property holdings.‡

Thus of the entire receipts for all of the railroads in the United States in 1911, three sevenths were paid in wages and salaries, and one fourth in interest and dividends. The approximate ratio between the amount of service income and the amount of property income on the railroads of the United States was therefore 12 to 7.

There is, of course, considerable variation from one part of the country to another, and from one class of railroads to another, in the ratio between service income and property income. The Interstate Commerce Commission has divided

* Statistics of the Railways in the United States, Interstate Commerce Commission, Washington, Government Printing Office, 1913, p. 53.

† *Ibid.*, p. 29.

‡ *Ibid.*, p. 53.

the country into three Districts,—the Eastern district, comprising "that portion of the United States bounded on the west by the northern and the western shore of Lake Michigan to Chicago, thence by a line to Peoria, thence to East St. Louis, thence down the Mississippi River to the mouth of the Ohio River, and on the south by the Ohio River from its mouth to Parkersburg, W. Va., thence by a line to the southwestern corner of Maryland, thence by the Potomac River to its mouth. The Southern District comprises that portion of the United States bounded on the north by the Eastern District, and on the west by the Mississippi River. The remainder of the United States, exclusive of Alaska and of island possessions, is included in the Western District."*

A similar division is made of the railroads into three classes based upon their financial importance. Class I includes those roads with gross operating revenues of $1,000,000 or more. Class II includes those roads which have gross operating revenues of $100,000, but of less than $1,000,000. Class III includes those roads which have revenues of under $100,000. An analysis of the returns from the United States by class and by districts shows that while the ratio between operating rail revenue and total compensation is comparatively stationary, at about 7 to 3, the ratio between the operating rail revenues and the total amount paid in interest and dividends varies considerably. On the larger roads (Class I) one fifth of the operating rail revenues is paid out in the form of interest and dividends in the East and in the South, while more than a quarter is so used in the West. The total of Class I roads shows a ratio between operating rail revenue and total interest and dividends of 4 to 1. On the Class II and Class III roads the ratio is slightly more than 5 to 1.

A brief summary of these facts compiled from the reports of the Commission gives an excellent idea of the general ratio on which the railroads disposed of $2,750,000,000 of gross earnings which they received in 1911.

* *Supra*, pp. 9, 10.

TABLE II.

OPERATING RAIL REVENUES, TOTAL COMPENSATION, AND TOTAL INTEREST AND DIVIDENDS, BY CLASSES AND DISTRICTS, FOR THE RAILROADS OF THE UNITED STATES. 1911.*

Classes and Districts.		Operating Rail Revenue.	Total Compensation.	Interest and Dividends.
Class I Roads	East	$1,180,093,370	$543,860,234	$233,945,112
	South	405,419,448	166,891,480	79,552,808
	West	1,107,005,585	457,104,180	312,426,020
	Total	$2,692,518,403	$1,167,855,894	$625,923,940
Class II Roads	East	$28,219,316	$12,358,326	$6,056,328
	South	11,588,011	4,223,821	2,639,861
	West	40,408,098	16,678,382	9,087,590
	Total	$80,215,425	$33,260,529	$17,783,779
Class III Roads	East	$4,158,947	$1,883,018	$835,461
	South	4,298,413	1,741,002	957,581
	West	8,570,481	3,726,027	1,983,436
	Total	$17,027,841	$7,350,047	$3,776,478
All Operating Roads	East	$1,212,471,633	$558,101,577	$240,836,911
	South	421,305,872	172,856,304	84,040,350
	West	1,155,984,164	477,508,589	160,917,046
	Total	$2,789,761,669	$1,208,466,470	$648,374,227

* *Supra*, p. 54, 55.

An analysis of the above table shows the Class II and Class III roads to be negligible factors. Together they report less than 5 per cent. of the total gross earnings. Interest must therefore center in the Class I roads, which are the important roads of the country. On these important roads, for each $100 paid in compensation, $54 is paid as interest and dividends. The ratio of service to property income is therefore, roughly, 7 to 4.

These facts derived from a general survey of the aggregate figures for the large roads of the United States may be checked and supplemented from various other sources. In addition to the reports published by the Interstate Commerce Commission, there are a number of states which publish reports on the railroads operating within the state boundaries, and upon certain railroads whose lines enter the state. An analysis of these figures throws additional light on the division of railroad revenue, by giving returns for individual states and individual roads.

The Public Service Commission for the First District of New York* reports for the steam railroads operating under its jurisdiction a total compensation of $559,544, and a total payment in interest and dividends of $209,792. The ratio of service income to property income is therefore approximately 5 to 2. These railroads are obviously of minor importance.

Two of the state railroad commissions publish returns for several of the larger railroad systems. The following table contains figures for a number of systems, compiled from the reports of the Minnesota and Iowa Commissions:†

TABLE III.

OPERATING REVENUES, TOTAL COMPENSATION, AND TOTAL INTEREST AND DIVIDENDS FOR CERTAIN RAILROAD SYSTEMS, 1911 AND 1912. (a)

Railroads.	Operating Revenues.	Total Yearly Compensation.	Total Interest and Dividends.	Ratio between Service and Property Income.
Chicago, Burlington and Quincy......	$86,723,000	$35,208,000	$19,563,000	2-1
Chicago and Northwestern........	73,699,000	28,068,000	19,227,000	11-6
Rock Island	61,871,000	25,982,000	16,755,000	3-2
Great Northern..	66,161,000	22,517,000	27,296,000	3-4
Northern Pacific..................	63,424,000	24,198,000	27,030,000	6-7
Iowa Central.............. ..	3,511,537	1,193,632	1,138,885	1-1
Santa Fé.........................	89,164,217	34,740,915	28,046,045	5-4

(a) *Supra*, pp. 54, 55.

A glance at the last column of the table in which a rough estimate is made of the ratio of service income to property income will show the variation which always appears when individual establishments are compared. The ratio for all of the roads between gross earnings and compensation is fairly uniform, ranging from 3 to 1 in the case of the Great Northern, and Iowa Central, to 2½ to 1 in the case of the other roads. The ratio between revenues and the amounts paid in interest and dividends shows no such uniformity. For the Chicago, Burlington, and Quincy the ratio of service income to property income is 2 to 1; for the Northern Pacific it is 6 to 7. Between these two extremes fall the other roads.

* Annual Report of the Public Service Commission of New York, First District, 1911, Volume II, pp. 19–20.

† Annual Report of the Minnesota Railroad Commission, 1912, Minneapolis, 1913, pp. 200–314. Also the Annual Report of the Board of Railroad Commissioners of Iowa, 1911, Des Moines, 1912, pp. 339–413.

This table shows this very clearly—that while a general statement may be made regarding the relation between operating revenue and compensation for the larger Western railroads, no such statement will hold for the ratio between compensation and amount paid in interest and dividends. The latter figure depends largely upon the prosperity of the individual road. Hence the variation is considerable.

This fact is further emphasized by some additional figures showing the ratio between operating income and total interest and dividends. (In none of these cases were the figures for total compensation available.) The Lake Shore and Michigan Southern reports an operating income of $48,452,126; dividends of $9,999,298; and interest of $6,379,832. This would make the ratio between operating income and property income 3 to 1.* The New York Central, with operating revenue of $100,-741,601, reports the payment of $18,868,966 in property income, a ratio of 5 to 1;† the Pennsylvania, with operating revenue of $157,234,107, reports the payment of $26,096,471 in property income, a ratio of 6 to 1;‡ and the Delaware, Lackawanna, and Western, with an operating revenue of $35,947,066, reports the payment of $6,028,800 in dividends (6 to 1).§

The railroad facts are well authenticated and fairly complete. For all of the leading roads, 44 per cent. of the operating rail revenues is paid for compensation, and 23 per cent. is paid for interest and dividends. The railroads of the United States in 1911 had completed the lines of a well defined picture of income values. Under the then existing arrangements, the owners of railroad property were receiving more than half as much as the people who do the work of the railroads.

The information regarding the other transportation industries is less satisfactory. There were in the United States in 1912, 30,317 telephone systems reporting an annual income of less than $5,000, with 1,228,935 miles of wire and 1,402,844 telephones.‖ The total income of these systems was $255,-

* Annual Report of the Michigan Railroad Commission, 1911, Lansing, 1912, pp. 199–208.

† Annual Report of the Public Service Commission of New York, Second District, 1911, Volume III.

‡ *Idem.* § *Idem.*

‖ Bureau of the Census, Bulletin No. 123, Telephones and Telegraphs, 1912, Washington Government Printing Office, 1914, p. 18.

081,234. Of this total, \$96,040,541 was paid out in the form of salaries and wages, \$20,163,960 in the form of interest, and \$34,120,809 in the form of dividends. The surplus was \$17,205,516.* In the telephone business the service income is almost twice as great as the property income.

The land telegraph systems of the United States report for 1912† gross receipts of \$52,337,211. Salaries and wages are reported as \$23,797,980, interest as \$1,608,593, and dividends as \$3,139,861. The ratio of service to property income is here about 5 to 1.

The data for express companies collected by the Interstate Commerce Commission show:‡

Operating revenue	\$76,198,754
Other income	5,633,792
Total Income	\$81,832,546

The total payments for interest were \$950,407; for dividends out of current income, \$5,928,104; out of surplus, \$26,775,727, making a total payment in property income of one third of the total income. The dividend payments out of surplus were swelled by a \$24,000,000 dividend paid by the Wells-Fargo Company. The credit balance carried from income to balance sheet was \$59,215,601.

The Iowa Railroad Commission furnishes two other classes of instances in which both service and property incomes are available. There are terminal railway companies in Iowa which report the payment of \$329,049 in wages and salaries, and \$37,553 in interest and dividends.§ The total operating receipts are comparatively small—slightly more than \$200,000 from rail operations with additions from rents of various kinds. The ratio between service and property income here is very much higher than that in the case of railroad companies. The Iowa report also contains an analysis of accounts of five

* Bureau of the Census, Bulletin No. 123, Telephones and Telegraphs, 1912, Washington Government Printing Office, 1914, p. 19.

† *Ibid*, p. 25.

‡ Statistics of Express Companies for 1910, Interstate Commerce Commission, Washington Government Printing Office, 1912, p. 15.

§ Annual Report of the Railroad Commissioners of Iowa, *op. cit.*, pp. [illegible].

bridge companies with a total capital of $12,625,800.* The income is derived from rail operations, joint facilities interest, and miscellaneous sources. During 1911, the total compensation paid was $41,443, the total amount of dividends $331,464, and the total amount of interest $87,500. Therefore the ratio of service to property income is 1 to 10. No conclusion can be drawn from these instances. They are inserted here merely because they indicate the extent of the variation which may occur between service and property income.

The transportation business differs from many other businesses. The gross receipts cover the return for service in its various forms, and there is no deduction from them as there is in manufacturing for raw materials. At the same time, the total amount of capital invested per employee is comparatively high, because of the great initial charge involved in railroad construction. Approximately half of the gross receipts of transportation agencies are paid out in the form of service income (wages and salaries). An amount is paid in the form of interest and dividends varying with the industry and the individual establishment.

The Answer for Municipal Utilities.

Another five years of investigation and of compilation by public utilities commissions will bring together data regarding the income from municipal utilities (street car service, gas, electric light, and water) as complete as that which now exists for the railroads. At the present time, the data are fragmentary in character. The Bureau of the Census has compiled, once in five years, a complete series of reports for the electric railways of the United States, showing the operating earnings, and dividends and interest paid, as well as wages and salaries. For 1907, the last of available data, the total operating earnings of the street and electric railways of the United States were $418,887,858.† The amount paid for

* Annual Report of the Railroad Commissioners of Iowa, *op. cit.*, pp. 504–516.

† Street and Electric Railways, 1907, Special Report of the Census, Washington Government Printing Office, 1910, p. 26.

wages and salaries was $150,991,099, while the total amount of dividends was $54,485,274, and the total amount of interest was $71,468,788. From these figures it appears that three eighths of the operating earnings on street and electric railways goes to the payment of service income, and five sixteenths to the payment of property income. The ratio between service income and property income is therefore 6 to 5.

In passing, it may be noted that on the street railway lines the interest charges exceed the dividends—the ratio between the two is 4 to 3. The ratio for all of the railroads of the United States is very similar ($406,000,000 and $291,000,000). In both cases the primary capital outlay is heavy.

A few state reports cover the same ground as that included in the Federal report. The Maine Railroad Commission* reports on the operations of 15 street railways in the state as follows: Total wages and salaries, $1,116,106; total dividends, $228,477; interest, taxes, and other charges, $784,029. Apparently the ratio of service and property income is approximately the same in Maine as for the country at large.

The Public Service Commission of the First District in New York† shows a total compensation of $28,632,580, and a total payment of interest and dividends of $12,204,640. Here the ratio of service to property income is 7 to 3. This ratio is considerably lower than that for the country at large.

One Minnesota street railway (the Minneapolis and St. Paul Company) with operating revenues of $444,504, reports the payment of $170,733 in total yearly compensation, and of $58,445 in interest and dividends. The proportion of service to property income is in this instance almost exactly 3 to 1.‡

The Census Bulletin for 1912 dealing with street and electric railways shows a gross income from all sources of $585,930,517. Payments for wages and salaries equal $200,890,939; the total interest charges were $98,025,338, and the total dividend charges were $51,650,117. The ratio of service to property income was therefore 10 to 7.§

* Annual Report for 1912, *op. cit.*, pp. 10–32.

† Annual Report for 1911, *op. cit.*, Volume II, pp. 123–326.

‡ Annual Report of the Minnesota Railroad Commission, 1911, *op. cit.*

§ Street and Electric Railways, 1912, Bureau of the Census, Bulletin No. 124, Washington Government Printing Office, 1914, p. 66.

A ratio apparently exists between operating revenues, and service and property income on street railways approximately similar to that for steam railroads. As in the case of railroads, there are variations in the ratio between service and property income from one establishment to another. The property income is relatively higher here, however, and the railroad ratio (12 to 7) is exceeded.

The data for other public utilities are far less satisfactory than those available for street and electric railways. For the First District in New York, the total compensation paid by gas companies was $8,894,766, while the total payments of interest and dividends was $10,548,564.* In the same district the electric companies paid $6,663,600 in compensation, and $5,395,654 in interest and dividends. The companies operating both gas and electric franchises in the First District of New York paid a total compensation amounting to $16,850,676, and a total of interest and dividends of $19,443,164. These figures obviously do not justify any general conclusion. The situation in smaller cities and towns may differ considerably. In New York, however, it appears that the payments of property income equal, or even exceed, the payments for service income.

Partial reports from a number of individual gas companies show the ratio between gross earnings, and interest and dividends. These gas companies are, for the most part, in small towns. The ratio runs at 3 to 1, 4 to 1, and 5 to 1.

The Wisconsin Railroad Commission reports on the operating revenues and the payments for interest and dividends of certain public utilities in 1911.† For gas utilities the ratio is 4 to 1; for electric utilities it is 4 to 1.

The relation between service income and property income differs little from that in the railroad industry. There are a few instances in which the payments of property income exceed the payments of service income. In general, however, the conclusions which apply to the railroads are equally effective in the case of public utilities.

* Annual Report of the Public Service Commission, 1911, *op. cit.*, Volume III.

† Annual Report of the Railroad Commission of Wisconsin, 1910–11, Madison, 1912, Volume II, Part IV.

THE ANSWER FOR MANUFACTURING INDUSTRIES.

The manner in which the values created in manufacturing industries are disposed of is far less clear than it is in the case of transportation and of public utilities. The books are similarly kept; the facts could be made as readily accessible, yet to date, there has been little effort to collect and analyze them.

It is interesting in this connection to bear in mind the relation existing between the values derived from transportation and from manufacturing. The railroads in the United States show for 1911 gross earnings of $2,750,000,000. During 1909 the "value added by manufacture" to the raw materials which entered into the manufacturing processes is reported by the census as $8,500,000,000. In other words, the total amount of values created in manufacture is approximately three times as great as the total created in the railroad industry, the figures for railroading being for 1911, and the figures for manufacturing for 1909.

The study of manufacture which was made in connection with the Twelfth Census (1900) contained the most complete statement available of the relation between service and property income in the manufacturing industries. There were 185 industrial combinations covered in the census investigations. The capital invested in these combinations was $3,093,095,868, the item for wages and salaries was $227,861,188, and the item for interest and dividends was $135,126,612. The ratio of service to property income is in this case 5 to 3.*

The only accurate up-to-date information on the relation between service and property income is that contained in a few scattered reports on individual industries. These figures are necessarily indicative rather than conclusive.

Three important companies engaged in the manufacture of iron and steel make reports which permit of analysis into service and property income. The Bethlehem Steel Corporation in its report for 1913 † shows the payment of $4,374,653 in interest and dividends, and $13, 993,417 in wages and salaries. At the same time, $7,500,000 was set aside for additions to

* Census of Manufacturers, 1900, Part II, pp. lxxvi–lxxix.

† Ninth Annual Report of the Bethlehem Steel Corporation for year ending December 31, 1913.

nd working capital, and the net earnings were of which $1,528,785 was applied for depreciation, ,517 appeared as surplus. The amount paid in ome is three times as great as the amount paid in come, but the amount of interest and dividends, nount set aside for additions to capital, plus the lmost exactly equal to the amount paid for services. ings of the United States Steel Corporation and of ic Iron and Steel Company were analyzed in great e recent Federal Report on the Steel Industry.* e total receipts of the United States Steel Corpora-ll sources were $618,911,430. Of this amount, 23 s paid out for wages and salaries, 16 per cent. was interest and dividends, and 5 per cent. was set rplus. The ratio of service to property income is to 2. Unfortunately the interest charge includes , replacement, and sinking funds. In this connec-teresting to note that in 1911, while $161,419,000 wages and salaries, the undivided surplus of the ation was $156,275,000, an amount almost equal paid in wages and salaries during that year.†
ublic Iron and Steel Company for 1911, with total $24,680,288, charged 30 per cent. to wages and sal- cent. to dividends and interest (including deprecia-terest charges), and had a surplus of 5 per cent. of ceipts.‡ The ratio of service to property income is

erial giving directly the amount paid by manufac-stries in service and in property income is meager in e. There are, however, two sources from which nation on the subject may be gleaned. On the the census data on manufacture give for all indus-r specific industries the total value of products and yments for wages and salaries. These figures show between gross value, or value added by manufac-service income. Several states publish like data.

itions of Employment in the Iron and Steel Industry, United States Bureau of Labor, Government Printing Office, 1913.
itions of Employment in the Iron and Steel Industry, *op. cit.*, p. 277.

On the other hand, a body of information exists in those corporation reports which gives gross income and total payments for interest and dividends. From these figures total property income may be ascertained. The two sets of figures certainly cannot be compared. Both, however, are suggestive.

The general census tables contain but a partial analysis of the disposition of the values derived from manufacturing. They report the values added by manufacture (the gross value or selling value of the materials minus the cost of the raw material), and the wages and the salaries. It is thus possible to show what part of the values derived from manufacturing was paid out in the form of service income. There is nothing in the census figures for 1910 that gives any clue to property income.

The value of all products produced by manufacturing industries in 1909 was $20,750,000,000.* The value added by manufacture was $8,572,527,000. The total amount charged against "services" (a term under which the census includes all salaries and wages) was $4,375,000. Thus almost exactly half of the value added by manufacture was paid out in the form of salaries and wages. The reader will remember, by way of comparison, that slightly less than half of the operating rail revenues of railroads was paid out as service income.

The ratio between value added by manufacture and total payment for services is not at all uniform in the different manufacturing industries. Indeed, the variation is many times greater than that shown by the statistics of railroads. While the ratio is 2 to 1, in the manufacturing industries at large, it stands 33 to 1 in the manufacture of distilled liquors, and 20 to 19 in the case of general shop construction by railroad companies. A table of the 35 industries in which the value of the products for 1909 is reported to exceed $75,000,000, shows that for the most part the relation between the value added by manufacture and the total amount paid for services remains fairly constant, varying between 5 to 2 and 5 to 3. In this entire group of industries there are six instances in which less than two fifths of the value added by manufacture is paid out in the form of service income, and five instances in which more

* Abstract of the Thirteenth Census of the United States, p. 436.

than three fifths of the value added by manufacture is paid out in the form of service income.

There are a number of state bureaus of labor which publish information regarding the total receipts from manufacturing, the cost of materials and supplies, and the total amount of wages paid. Unfortunately, there are no instances in which the states report the amount of salaries as well as the amount of wages. The information available in the state sources must therefore be regarded as of distinctly inferior value to that in the Federal Census.

The state of Oklahoma furnishes information regarding its manufacturing industries for 1911.* During that year, the total receipts from the sale of manufactured products were $81,857,148. The figures in this report show that the cost of materials used in the manufacturing industries of Oklahoma is five eighths of the total value of the products. This proportion is the same as that shown by the United States Census figures. Of the value added by manufacture, 45 per cent. was paid in wages. If salaries had been included in this statement (they usually amount to about 5 per cent. of the value added by manufacture), the ratio of value added by manufacture to service income would be virtually the same as that reported by the United States Census.

New Jersey and Massachusetts publish statistics showing the value added by manufacture and payments in the form of wages. The figures for Massachusetts vary somewhat from those of Oklahoma.† The Massachusetts industries are primarily textile. The wages paid in these textile industries are lower, and a smaller proportion of the value added by manufacture is paid to the wage-earners. An analysis of the figures published by the New Jersey Bureau of Statistics‡ shows a situation which differs very little from that recorded in the United States Census and in the Oklahoma report. On the whole, it may be fairly said that the state reports do not differ in any material way from the figures published by the latest Federal Census.

* Annual Report of the Department of Labor, Oklahoma, 1911-12, Oklahoma City, pp. 150-153.

† Twenty-fifth Annual Report of the Statistics of Manufacturers, 1910, Bureau of Statistics, Boston, 1912, pp. 2-12.

‡ Bureau of Statistics of New Jersey, 1911, Camden, 1912, pp. 10-26.

A generalization is permissible at this point. It seems to be true that about one half of the value added to the raw materials by the American manufacturing industries is paid out as wages and salaries, while those with a comparatively small capital investment report a far larger proportion. Although the generalization does not hold true for specific industries, it does seem to be borne out by the results obtained by state as well as Federal studies.

The figures showing the relation between gross values or total values created in the manufacturing industries, and the payments for service income, are far less usable from a statistical standpoint than the figures showing value added by manufacture. The immense difference in the net value of raw materials leads to wide differences in the ratio of gross values to service income. The total figures from the census shows that of the gross value created in manufacture, the amount paid in wages and salaries constitutes about one fifth for all industries. This proportion seems to be a representative one.

However desirable it might be to reject these figures for gross values and adhere to the values added by manufacture, the manner in which most industrial accounts are kept do not permit of any such procedure. If service and property incomes in the manufacturing industries are to be compared, attention must center on gross returns, because that is the only figure which appears in corporation accounts. Even that is absent from most accounts, or else a complication of accounting prevents the student from determining the amount of interest or of dividends. There are a number of manufacturing industries, however, for which the manuals publish fairly satisfactory data.

One of the most frequently discussed companies is the Pullman Company. This company, with a capital of $120,000,000 (no funded debt) reports for 1912–13 total revenues from all sources:—

car operations	$40,103,216
operations	1,091,875
turing plant	31,320,181
	$72,415,272
orate income	14,714,704
s, 1912–13	9,439,769

(for the accounts are not entirely clear) the total revenues and the amount paid in divi- 1, while the ratio between total revenue and the t corporate income is 5 to 1. In this connection, emembering that although the amount paid in the Pullman Company is only one eighth of the s, the Pullman Company has increased its capi- 000,000 to $120,000,000 by declaring stock divi- here is there adequate statement to show the gross earnings which the Pullman Company e income.

between gross earnings, the amount paid in in- vidend, and the amount set aside as surplus by nies which make fairly complete reports, appears g table:

TABLE IV.

COME TO PROPERTY INCOME AND TO SURPLUS IN CERTAIN REPRESENTATIVE INDUSTRIES.

ies.	Year.	Ratio of Gross Income to	
		Interest and Dividends.	Amount set Aside as Surplus.
ompany	1910–11	20 to 1	25 to 1
any	1909	20 to 1	25 to 1
rks	1912	12 to 1	16 to 1
Company	1912	7 to 1	20 to 1
y	1912	16 to 1	50 to 1
ny	1911	11 to 1	14 to 1
pany	1910–11	16 to 1	30 to 1
ny	1910	12 to 1	3 to 1
Company	1911–12	11 to 1	50 to 1

few smaller companies for which the figures These cases, most of them among the success- ufacturing concerns, illustrate the extent of the

stics, New York Manual of Statistics Company, 1913, p. 785.

variation and the general ratio existing between gross income and property income. Apparently from 5 to 10 per cent. of the gross income of such companies goes for the payment of interest and dividends. It will be remembered that for all manufacturing industries the percentages paid in service income was about 20 per cent.

The student will note with keen disappointment the lack of adequate data on which to base any general statement of the ratio between service and property incomes in the manufacturing industries. That the figures are as readily obtainable for the larger manufacturing industries as they are for the railroads and other public utilities goes without saying. They cannot be worked out and satisfactorily presented until a thorough expert study is undertaken by some official body. Probably real enlightenment in this direction lies in the creation of a commission with powers like those of the Interstate Commerce Commission, to compel the keeping of uniform accounts.

For the time being this much may be said. Half of the total value added to the raw material by the processes of manufacture is paid out in the form of service income. The proportion paid in property income is less, very much less, in fact, although no defensible statement may be made in terms of figures. Of the gross income from manufacturing industries, a fifth is paid out in the form of service income, and a considerably less proportion takes the form of property income.

Mining, Smelting, and Refining.

Perhaps the Michigan Copper strike revealed a unique example of the relation between service and property income. At the same time, the strike resulted in the publication of some significant facts regarding the income situation in the copper mining industry, and showed that certain of the properties were yielding immense returns on the capital invested.

The full text of an illuminating report* throws into the foreground the operations of the Calumet and Hecla Company, and the companies which it controls. The actual cash

* Michigan Copper District Strike, United States Bureau of Labor, Bulletin 139, Washington Government Printing Office, 1914.

paid into this company seems to have been $12 per share on 100,000 shares, the par value of which is $25. The Calumet and Hecla Company reports for 1912 $4,364,360 paid in the form of interest and dividends, and $3,193,073 paid in wages. Exactly what percentage of the total compensation this term "wages" includes, the report does not make clear. If the ordinary relation between wages and salaries exists, about 5 per cent.* should be added to this amount in order that the total amount paid in the form of service income may be ascertained. The amount of interest and dividends is considerably in excess of the total amount paid in wages and salaries.

An examination of appendices 2 and 3 in the same report shows that while the Calumet and Hecla Company is the largest and apparently by far the most successful of the companies reporting, there are other ventures almost equally successful. The ratio of service to property income in the case of the Calumet and Hecla Company is probably unique. At the same time, it is one instance, on a huge scale, of an industry which pays more dollars per year, to the holders of the property than to the people who carry on the work.

The figures showing the relation between service and property incomes in the mining industry are far from satisfactory. The figures published in the Thirteenth Census† show a total value of the production of mines and quarries of $1,238,410,000. The expenses of operation and development were $1,042,634,000. This total includes the expenditures for services, supplies, royalites, taxes, contract work, rents of offices, and the like. Apparently all of the costs of the business are included except the payment for interest and the fund for dividends and surplus. Although it would seem that the $200,000,000 of difference between value of products and expenses of operation represents property income, surplus, depreciation and insurance, such an inference is wholly unsupported, and may be unjustified.

The census does make clear the relation between the value of products and the costs of operation, on the one hand, and

* Abstract of the Thirteenth Census, Table 110, pp. 514 ff.

† Mines and Quarries, 1909, Bureau of the Census, Washington Government Printing Office, 1913, pp. 334–335.

[illegible] payment for services on the other. The total expense fo[r] services was $662,422,000, or about one half of the value adde[d] [illegible] products and three fifths of the total cost of operatio[n]. Among the principal mining industries the proportion of tot[al] value of products to service income is about 2 to 1. It [illegible] highest in bituminous coal mining (4 to 3), and lowest in th[e] production of petroleum and natural gas (5 to 1). For th[e] most part the ratio holds fairly constant.

The census report on Mines and Quarries for 1902* co[n]tained an analysis for all incorporated companies showing th[e] total amount paid in wages and salaries, and the total amou[nt] paid in interest and dividends. The value of products fo[r] 1902 was $[illegible]: the total of wages and salaries wa[s] $[illegible] and the total of interest and dividends wa[s] $[illegible].† The ratio between total value produced an[d] service income was therefore about 2 to 1, and between tot[al] value and property income, 9 to 1.

Such fragmentary information in the mining industry [illegible] may be gathered from the manual of industrial statistics show[s] that the variation between total earnings and property incom[e] is extreme. Few of the mining companies making repor[ts] have funded debts. They are, for the most part, capitaliz[ed] by the issue of stock, on which the dividends vary widely.

Service and Property Incomes.

Any one who sets out to find for service and property incom[es] a fixed rate which will hold true among all industries, or th[at] will hold true throughout any one industry, is doomed to bitt[er] disappointment. No such ratio exists, and in the very natu[re] of things, it cannot exist. Variations in the conduct of ind[ivid]ual businesses, and in the character of various classes [of] businesses, necessarily lead to variations in the service—pro[per]ty income ratio.

A fixed formula between service and property income is n[ot] in any sense indispensable, however convenient it may b[e]. The important fact lies in the existence of a demonstrab[le] relation between service and property incomes.

* Special Report of the Census Bureau, Washington Government Printing Office, 1906.

† [illegible] pp. 85 and 88.

The business accounts of today give no clue to "rent, interest, wages, and profits." In so far as modern accounting is concerned, the terms as they were used by nineteenth century economists are obsolete. In their place appears a new terminology including such words as "compensation," "dividends," "interest," and "surplus." Compensation is service income; dividends and interest are property income; surplus is undistributed income, or income the distribution of which has not yet been determined. If the economists is to talk in terms that the man on the street can understand, he will have a distinction between service and property income that is clear-cut and logical, on the one hand, and which, on the other hand, is being constantly more definitely formulated and lived up to by the world of affairs.

The data for distinguishing service from property income are as yet incomplete. Yet the logic of the distinction seems no less inevitable than the trend of fact in that direction. As the material aggregates it will become more and more clear that the income issues of the next generation must concern themselves with incomes from services, on the one hand, and incomes from property on the other. The distinction is vital, and it takes added significance with each passing year.

REVIEWS AND NOTES.

ANNUAL STATISTICAL REPORT OF THE BOSTON CHAMBER OF COMMERCE—1913.

Commercial organizations in the larger cities are more and more seeking out and advertising every commercial and industrial advantage which their city affords. To do this intelligently and comprehensively statistics showing the city's activities are necessary, and trade bodies are making it a practice to publish such figures. One of the most recent and complete publications of this nature is the Annual Statistical Report of the Boston Chamber of Commerce, 1913.

This report is a neatly bound volume of about 100 pages and although the tables are not numbered, making reference to them difficult, their well-arranged headings and rulings add to the clearness of the book.

Statistical exhibits of three general classes appear in this report. Approximately one third of the material is devoted to a presentation of the facilities for, and the extent of sea-going trade through the Port of Boston, or the District of Massachusetts as it is henceforth to be called. A second short section contains tables showing bank clearings, property valuations, railroad operations, etc. The remainder of the book is given over to tabular material presenting the volume, price, and movement of produce, meats, and similar commodities in the Boston market.

The material is largely assembled from other reports rather than being an original compilation and is of the character commonly presented in the statistical reports of such bodies. As far as the inclusion of material is concerned, the report covers the field in a fairly thorough manner. Nevertheless, like so many similar publications, the book seems to have suffered somewhat from lack of organization and point.

The data describing the activities of Boston as a shipping centre are of especial interest at present since Boston is fully awake to her port development and the growth of foreign trade through that district. This material, however, would be of greater value if it included the corresponding figures for other leading ports, as well as for the United States as a whole. Only by the inclusion of such a background, against which to measure the present status of the port, can the trend and the comparative volume of its trade be shown. As a single illustration, importations of mahogany have fallen off enormously in that district in recent years and yet the report does not show whether there has been a similiar decline in importations of this commodity at other Atlantic ports.

Again, Boston's position as a world port would be more clearly shown if the foreign countries with which she exchanges commodities were given in the list of "Imports and Exports from Boston in Detail." This would also add value to the list for persons interested in specific commodities.

In connection with such a rapidly-growing port, information in regard to its physical equipment might well be added. In this connection the length of the waterfront, increasing wharfage, etc., would be of interest.

The three or four pages showing financial and similar data would seem to be capable of enlargement. For example, assessed property valuations are shown over a series of years. The value of this material would be increased if this table were modified so as to show Boston's total assessed valuation, together with corresponding figures for other cities of the first-class, and all valuations reduced to a uniform basis by applying to each total the percentage of assessed to actual value. Such a table would be indicative of the city's comparative growth in wealth and would be especially interesting since the report omits a statement of the volume of the building permits issued by the city.

A far more serious lack is the entire omission of industrial data, notwithstanding the fact that Boston is one of the largest manufacturing centres in the country.

Finally, textual analysis is nowhere attempted. General summary statements, calling attention to the development and progress of the city, as brought out in the tables, would add to the value of this report and of all reports of this nature.

William H. Mahoney.

IN MEMORIAM.

We regretfully record the death of two honorary members of the Association. Dr. Robert Meyer, of Austria, died on the 10th of June of this year, and Dr. Archibald Blue, of Canada, on July 27.

Dr. Meyer was a Privy Councillor and at one time Minister of Finance for Austria; president of the Central Statistical Commission; honorary professor of the Imperial University of Vienna; vice-president of the staatswissen-schaftliche Staats-Prüfungskommission and vice-president of the International Statistical Institute, etc. His influence on the statistical work of Austria and her dependencies was of lasting value. The memorial volumes published in celebration of the Fiftieth Anniversary of the Central Statistical Commission of Austria last year owe their excellence largely to him. He personally contributed some notable articles, among them one defining the relation between mathematics and statistics. Probably one of his latest undertakings was an article on the development and progress of statistical work in Austria, prepared for the memorial volume of this Association. Dr. Meyer was an altogether notable personage in Austrian life and will be greatly missed.

From the *Census and Statistics Monthly* for the Dominion of Canada we append the following sketch of Dr. Blue's life and activities:

"Dr. Blue was born on February 3, 1840, in the township of Orford, County Kent, Ontario, his father, a Gaelic Scotsman who died a centenarian, having come to Canada from Lochilhead, Argyllshire. Mr. Blue,

after experience as a school-teacher, entered journalism, serving successively on the editorial staffs of the *St. Thomas Journal* (1867–1879), the *Toronto Globe* (1879–1880) and the *Toronto World* (1880–1881).

"In 1881 Mr. Blue organised the Ontario Bureau of Industries of which he was Secretary from 1882 to 1891. In this capacity he instituted the useful agricultural statistics and crop reports of the Ontario Department of Agriculture, preparing for nine years the annual reports thereon. From 1884 to 1891 he was Deputy Minister of the Ontario Department of Agriculture and from 1891 to 1900 Director of the Ontario Bureau of Mines. Appointed in 1900 by the Hon. Sydney Fisher, then Canadian Minister of Agriculture, as Chief Census Commissioner, Mr. Blue conducted the Fourth Census of Canada in 1901 and wrote the elaborate introductions to the reports of that Census on natural products and manufactures. On the organisation of the present Census and Statistics Office in 1905, Mr. Blue was appointed Chief Officer, and the Northwest Census of 1906, as well as the Fifth Census of 1911, were carried out under his general direction. In 1908 he instituted the present system of agricultural crop-reporting for the Dominion and started the Census and Statistics Monthly.

"In 1888 Mr. Blue served as a member of a Commission appointed to inquire into the mineral resources of Ontario, and he was a delegate to the Deep Waterways Convention of 1894. In 1908 he was elected as an Honorary LL.D. of McMaster University at Toronto; and he was a representative of Canada at the General Assembly of the International Agricultural Institute, held at Rome, Italy, in December, 1909, when he presented the paper on Crop-Reporting in Canada which was published in the *Census Monthly* of February, 1910. In February of the present year he was elected as an Honorary Member of the American Statistical Association on the occasion of the celebration of its Seventy-fifth Anniversary.

"Wielding a vigorous and facile pen, Dr. Blue, during a long, strenuous, and useful career as public servant, was the author of numerous articles ranging over statistical and economic subjects, whilst his genial and unassuming disposition secured for him widespread friendship and esteem."

J. K.

THE AGRICULTURAL CENSUS OF 1910.

The last census is the result of the greatest expenditure of money, and the employment of the greatest number of scientific experts thus far devoted to any one statistical inquiry in the country. It has been called "a college man's census." The director was a man of scientific training and years of scientific experience. One of the first moves of the director after assuming his new duties was the calling together of experts to aid in determining the plans and scope of the census and the formulation of the schedules to be used by the enumerations. The wisdom of this method of procedure can hardly be called in question, yet the conservatism lurking in a government bureau, even under a new director, is such that innovations are with difficulty inaugurated. In this case a very large part of the good

advice of the experts was rejected at the last moment and the schedules put back into the forms agreeable to a few men not too familiar with the facts of agriculture.

In the main the agricultural schedule of 1910 is very similar to that of 1900 but materially more elaborate. This further elaboration of preceding schedules has long been in progress. For example, a maximum of forty-eight questions were asked of each farmer in the census of 1860, and twice that number sufficed for the "Domesday" inquiry of 1880. In 1900 a total of 306 questions were included in the schedule, while in 1910 the number had grown to 560. That this latter number is too great is the belief of substantially everyone from director down to enumerator concerned in the census work. Nevertheless, the information asked for is, almost without exception, of much value. The difficulty was to get it, for even with the most painstaking care in the matter of instructions to enumerators many of them failed to comprehend what was wanted. Worse yet, many farmers felt that it was an imposition to ask them to answer in such minute detail questions on which they had little accurate information. For instance, a farmer was usually interested in reporting the acreages of grain and hay, the yields of the same, the number and value of livestock, but he was likely to lose interest, and incidentally faith in the census, when asked to report on the quantity and value of vegetables raised in his kitchen garden.

Back of the work of the Census Bureau in taking the census are several matters over which Congress has control and which need attention. The weakest factor in the whole census group is the enumerator. Here is work requiring expert knowledge and experience to be done by a vast army of inexperienced people, employed for a single month, at a wage not attractive to responsible and capable workers in any but exceptional cases. This difficulty can probably not readily be remedied so long as we continue to take the census within a given month during the spring or early summer. On the other hand there is in each congressional district a "supervisor of the census" who has it within his power to correct many of the evils due to the shortcomings of the enumerator. This supervisor is, due to the exegencies of politics, not appointed by the director of the census. He is virtually appointed by the congressman from the district. This precludes, in the great majority of cases, the possibility of expert supervision. As a result, a great many errors which could quite readily be checked up and eliminated by a competent supervisor, pass on to the Census office where correction is more difficult and in many cases impossible.

Another matter over which Congress has control is that of the time of year for taking the census. Surely the change from June 1 to April 15 was not made in the interest of agriculture however favorable it may be for other branches of the work. With respect to crops of the preceding year, the change made little difference; for the question as to crop acreages for the census year April is distinctly less favorable than June. However, it is in the very important matter of livestock that the worst results are to be noted. One of the main values of census figures is for comparisons

which are made possible, comparisons of like facts for different dates. Th status of the livestock situation on April 15 is essentially unlike that o June 1. During this period, within a large part of the country, the greate number of young are born. Moreover, the number of colts, calves, an pigs raised during a given year shows as nothing else can the status o the livestock industry with respect to future prospects. These facts ar wanting and the value of the thirteenth census in much less than it other wise would be. Every friend of the agricultural census work should exe his influence to have the time of the census taking changed once more The most favorable time would undoubtedly be after the work for the yea is substantially over and before the occupier of the farm has moved to hi next holding. Over one sixth of the American farmers move each year and it is difficult, often impossible, to get statistics for the farm after th farmer has moved away. Taking the census in the early winter woul give the best possible results as to crops grown, animals raised, land tenure farm mortgages—in short, for substantially the entire schedule.

Congress played a poor rôle in the management of the census finance during 1910 to 1912. A fairly liberal appropriation was made for the tak- ing of the census. However, some important stipulations were made neces- sitating unusually large expenditures. The work went on, and the expiring congress saw that more money was to be needed in order that the vast amount of information contained on the schedules might be made avail- able. However, it was decided that money enough for the time interven- ing between that time and the meeting of the next congress was all that wa imperatively needed. The next congress was of a different political com- plexion and indisposed to show much consideration for the unfinished work of its predecessor. Hence the census was left stranded between two port either of which would have been welcome and either of which should have offered the required help. Trained clerks were discharged and work under way was abandoned. As a result, money was ultimately wasted, and some of the most interesting and valuable of the statistics are aging on the census shelves.

In spite of all discouragements and mistakes the agricultural census of 1910 is the best yet published. It contains the most information, and by all means presents it in the most available shape. The general report is confined to one volume. In this is to be found the leading facts classified under twelve headings, viz: Farms and Farm Property, Farm Tenure, Farm Mortgages, Statistics of Farms by Race Nativity and Tenure, Size of Farms, Livestock on Farms and Elsewhere, Livestock Products and Domestic Animals Sold or Slaughtered on Farms, Summary for All Crops, Individual Crops, Agricultural Statistics by Counties, Irrigation, Planta- tions in the South. An appendix treats of the physical features and soils of the United States. With the exception of one chapter the facts are presented by states only. In the chapter giving county figures the statis- tics of several preceding chapters are shown, the difference being in the matter of detail. The tables in this volume are a distinct improvement over similar tables in former volumes. In addition to text and tables an

elaborate series of maps is presented showing the geographical distribution of substantially every species of farm property and product.

The more detailed information is published in two volumes made up of state bulletins. These volumes are very usable. The state is accurately described as to soil; the leading statistics are presented in a series of small state tables accompanied by suitable text; detailed statistics are given by counties. So far as possible comparative figures from preceding censuses are given in the state tables. All in all it will be less frequently necessary to turn from one census report to another in making comparisons than has heretofore been the case.

A unique feature of the publications is the combining of each of the state bulletins with the Statistical Abstract of the whole census for use in the respective states. This gives to a great number of people all the information desired and saves sending out the complete volumes where this combination serves the purpose as well or better.

Statistics according to age of farmer; much information concerning rented farms; and the same for mortgaged farms are three items of importance on which the census bureau still has the unpublished facts. These are facts which should be made available, no doubt they will be, but the longer they are in appearing the less will be their value.

It is to be hoped that a more satisfactory and less expensive method of gathering agricultural statistics may be devised. Making use of the rural mail carriers has been suggested, and the suggestion merits consideration. It may be found feasible to specialize, as it were, with respect to inquiries made at a given time, putting the emphasis on one subject at one census and on something different at another. There is good reason to believe that our agricultural census figures are reasonably reliable. What is needed is greater facility in gathering them, and much greater speed in preparing them for use.

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THIRTEENTH CENSUS OF THE UNITED STATES—MANUFACTURES, 1910.

Volumes VIII, IX, X, Census Office, Washington, D. C.

The statistics of Manufacturers for the Thirteenth Census of the United States constitute three of the twelve volumes (including the Abstract) of the Report. Volume VIII is entitled "General Report and Analysis"; Volume IX, "Reports by States, with Statistics for Principal Cities"; and Volume X, "Reports for Principal Industries." Volumes IX and X contain essentially the same data that are found in Volume VIII, but treated in more detail, and arranged either primarily by states and cities, or by industries.

The data presented were collected for the most part by special agents appointed for that purpose. In remote districts the population enumera-

tors either aided in the collection or completely collected the data aske for on the General Schedule. The questions asked relate to a few funda mental facts. All "establishments" returned the General Schedule, whil in the case of some sixty-two industries, special or supplementary que tionaires were used.

For the most part, the questions asked in this Census are comparabl to those asked in the 1900 Regular Census, and in the Special Census c 1904. The 1909 Census, like that of 1904, was "confined to manufactu ing establishments conducted under what is known as the factory system exclusive of the so-called neighborhood, household, and hand industries. The Twelfth (1900), and preceding censuses were not so restricted, but i the Report under discussion the statistics for 1899 (1900 Census) wer revised so as to exclude the establishments which would not have bee canvassed under the instructions for the later censuses.

In two important respects the scope of the Census of 1909 differed fron that of the Census of 1904. In 1909, reports were secured for all flou and feed mills, grist mills, and saw mills (omitting those with product valued at less than five hundred dollars in 1909), including even those grind ing or sawing for a fixed charge, and not owning the materials and products The latter—the "custom mills"—were not canvassed in 1904. The Cen sus of 1909 also included statistics of steam laundries.

In 1904, 339 industrial groupings were used; in 1909, 264—a reductio of 75 industrial classes having been effected. In each case the governin condition in industrial grouping is the "product of chief value" (Vol. VIII p. 37), but by this means too great emphasis is given to some industries and not enough to others, when a certain product is put out as a by-product but the industry producing it is classified otherwise because of the mai product. Industry totals do not, therefore, give an accurate index of th relative importance of the industries. Changes in the relative amount o various products, and their values, make it necessary to classify estab lishments differently at different censuses, and thus impair strict com parability. The dangers and problems accompanying this phase of th subject are adequately treated in Volume VIII, pages 37 to 39, while th complete industrial classifications and the changes made in them in 1909 as contrasted with 1904, are given in full in Appendix D, pages 819 to 832 of the same volume.

In no prior census have we been furnished with the figures of "Valu Added to Materials by Manufacture." It is evident that no manufac turing establishment, as such, produces the "whole of any commodity." The materials used come to it from various sources, and in all stages o manufacture. The only method, maintains the Census, of measuring th economic importance of the manufacturing process, is by determining th added utility, or money value, of the materials transformed in the process The value is "in most cases, substantially the difference between the cost of the materials and the value of the products" (Vol. VIII, p. 23), and the statistics shown are, "in each case," this difference. Such figures are "particularly valuable because they are almost entirely free from the dupli-

cation that appears in the total value of products" (Vol. VIII, p. 23). The duplication possible is with "contract work," and constitutes 2.1 per cent. of the value added by manufacture (Vol. VIII, p. 24).

A new inquiry, specified in the Census law, is the number of stockholders. Provision is made for this fact in question 1, but the data collected are not published, and justly so, since number has no significance without the amount and character of the respective holdings. Such inquiries, of course, have no place in a general manufacturing census.

As contrasted with the Census of 1904 and 1899, which sought to ascertain the number of persons employed at different rates of pay, and to segregate the amounts paid to men, women, and children employed as wage-earners, the Census of 1909 asked merely for the aggregate amount paid to each of the following classes: salaried officers of corporations; superintendents and managers; clerks, stenographers, salesmen, and other salaried employees; and wage-earners, including pieceworkers. Fortunately we are relieved in this Census from having computed for us, and injected into the discussion, all references to an average wage.

The inquiry relating to number of persons engaged in manufacturing industries was simplified in the 1909 census. Sex composition was required for salaried employees, and sex and age—sixteen years of age and over, and under sixteen—for wage-earners, including pieceworkers. The numbers, in both cases, were to be reported as per pay-roll on the fifteenth day of December, 1909, or the nearest available date. In 1904, the greatest and least numbers employed at any time during the year, by sex and age—men and women separately, sixteen years of age and over, and children under sixteen years without respect to sex composition—were required. Moreover, the schedule called for the average number by months, and by sex and age. Briefly, the difference is between those actually employed on a certain date, as taken from the pay-roll, and the greatest and least number employed at any time by sex and age, distinction being made by sex for those under sixteen years of age, in 1909. In 1909, the actual number of wage-earners on the fifteenth day of each month, as per pay-roll, without respect to sex or age, is required, while in 1904 the question called for the average number of wage-earners employed during each month, classified by sex and age. In spite of these differences, "It is believed . . . that the figures for three censuses (1909, 1904, 1899) are substantially comparable in a great majority of the cases" (Vol. VIII, p. 276). Especially is this held to be true when the statistics relate to large numbers, as for example, to industries as a whole, or to state totals.

The sex and age composition of the wage-earners by months for the 1909 Census is computed as follows, from the sex and age composition for December 15, 1909: " . . . The per cent. distribution by sex and age of the wage-earners in each industry for December 15, or the nearest representative day, has been calculated from the actual numbers reported for that day. This percentage has been applied for the average number of all wage-earners for the year in that industry, and thus an estimate of the average number of men, women, and children employed during the year

has been obtained. These calculated averages for the several industries in each state have been added to give the average distribution for the state as a whole, and the sum of these averages for the several states has been used to determine the sex and age distribution of persons engaged in manufacturing industries for the country as a whole" (Vol. VIII, p. 238).

The average number employed during the year is interpreted to mean the number that it would be necessary to employ throughout the whole year to turn out the value of product actually produced. Accordingly the wage-earners reported for each month are added together and the sum divided by twelve. In this respect the statistical methods for 1904 and 1909 are comparable.

In summary, the facts for each establishment available for presentation relate to location and character of organization, time in operation, capital employed, persons employed, both salaried and wage-paid, materials used, miscellaneous expenses, value of product, power employed, and fuel used. There is almost no limit to which the facts recorded under these various captions, for a country as large as ours and with such diversified industries, can be classified. Obviously, however, intricacy and detail of presentation can only be justified statistically when the data are either fairly accurate or typical, or are affected by errors which tend to compensate each other. Political considerations may prompt intensive allocation of capital employed, wages paid, value of product created, etc., by political jurisdictions, by industries, by size of establishments measured by various standards, but the query must always remain to one who has serious interest in the use of such data and an appreciation of their limitations, as to the propriety of this refinement, from the points of view of both cost and purpose. "Capital employed" is a dangerous statistical unit, both for absolute and comparative purposes, even when carefully measured; gratuitously furnished, with little or no opportunity for verification even within the widest margins, save those which are evident on the face of the census returns, its tabulation in detail is without statistical warrant. No one is more convinced of the limitations of this unit than the Census office, yet seemingly because of political necessity, not only is the capital employed required to be reported, but it is tabulated in the greatest detail, made a cardinal factor in industrial ranking, at the same time that there is printed page after page of conclusive and unmistakable declarations that it is not relatively or absolutely worth the paper upon which it is printed. The Census office, in text analysis, never loses an opportunity to counsel against any weight being assigned to the concept. The only regret is that each column where it appears is not marked with an asterisk, and the following note appended: "These data are meaningless: They are collected and printed only because the law requires it." Consistency as between text and statistical tables would demand some such insertion.

The same considerations, and with equal force, apply to data on "Value of Product." The figures printed have little if any statistical worth, either for one industry or for combined industries. The duplications of value are frequently and unmistakably pointed out by the Census office,

and cautions against the use of the data in any definite or specific sense are found throughout the Reports under review. In spite of this fact, by legislative mandate, the data are collected, and, seemingly, by political necessity, the totals in divided, subdivided, and dissected form are strewn throughout almost every page, giving the value of product to the nearest dollar, for instance, for combs and hairpins (Vol. VIII, p. 485), hones and whetstones, in Indiana (Vol. VIII, p. 721), etc. The data are elaborately tabulated by states by industries (Vol. VIII, General Table VI), by industries by states (Vol. VIII, General Table V), by summaries for states (Vol. VIII, General Table IV), etc., etc. From a statistical viewpoint this is hardly less than farcical.

Moreover, considerable importance is ascribed by the Census to the unit "Value Added by Manufacture," since the amount of duplication as between establishments and industries is largely eliminated. And yet this item is computed as the difference between the value of the product and the cost of materials used, against the use of which justified warnings are constantly urged. It is not clear how such sanctity may characterize the offspring of such contaminated parents. We do not have a condition here where error tends to correct itself, but rather where it becomes cumulative. Neither is this a case where an essentially correct idea may follow from data in and of themselves misleading. Neither of these statistical truths control. The regrettable thing is that legislative injunction requires the collection of this type of data, and that political pressure seems to demand their detailed tabulation. What is said respecting capital, value of product, and cost of material, is directed against the method and circumstances of collection, rather than against the desirability of the data if correctly determined. Such statistics *per se* would be harmless if they were used understandingly. Unfortunately they are not, and the cautions strewn throughout the text—which only the discriminating see—do not avail to prevent false conclusions from being drawn from them. Pressure of time, lack of money, the method of collection, and the uses to which they are put, all combine to make the wisdom of their publication highly questionable. So long as the law requires their collection, it might be argued that their possession justifies publication. Such conclusion does not necessarily follow— at any rate, publication in the present form. Our criticism is directed both to the collection and elaborate tabulation of meaningless and, for all scientific purposes, useless data. If the legislature will not relieve us from collecting them, the limited discretion given the Census office in the matter of publication should be directed toward lessening the necessary evil of detailed publication.

Much the same line of criticism might be extended to the captions, "Cost of Materials," and "Power Used." The space allowed for this review will not permit of an extended treatment of these items.

As for the other inquiries, they primarily relate to matters which may be enumerated, and in which the motives to under—or over—evaluate, or to wilfully misstate, are not controlling. Difficult as is the formulation of a definition of an "establishment," the basis for classification is in the dis-

cretion of the Census office, and the lack of comparability may be reduced to a minimum.

Collection of data on wages and salaries paid does not offer insurmountable obstacles. The Census office undoubtedly has acted wisely in protesting against the use of wages paid to measure the proportion of value of product which goes to this factor, and against the practice of making direct or indirect comparisons of the relative amounts paid in wages and in salaries.

Likewise respecting the number of salaried employees and wage-earners, the chances for misleading facts in this census are reduced to a minimum. The data are taken from the pay-rolls, and applied to a certain day of the month. The industries in which the facts reported for this month are not typical are comparatively self-evident, and errors through comparison or by absolute statement are not likely to be serious.

The table of contents outlines each chapter fully, the character of the matter being indicated by such headings as "Introduction," "Summary," "Principal Tables," "Diagrams." Following the fifteenth chapter are six so-called General Tables (pages 507–793) and following this, four Appendices (pages 797–832). The volume also contains an elaborate "Index to Industries, by Chapters and by General Tables."

Of the Introduction, Chapter I, nothing needs to be said, save that there is here reproduced, in summary, the essential cautions and instructions issued with the schedules, with the Instructions to Special Agents, and with the Instructions for Editing and Revising the Schedule, as well as the salient points in which the 1909 schedules differ from and agree with those of the censuses immediately preceding it.

From the reviewer's viewpoint one of the chapters in Volume VIII against which the most vigorous protest should be directed, is Chapter IV—Summary by States and Geographic Divisions. In this chapter the various states are ranked according to criteria furnished by data on the schedules—value of products, wage-earners, and value added by manufacture, being the controlling items. In Table 4, page 61, the ranking is according to amount and percentage of increase in value of products from 1899 to 1909; in Table 5, page 62, the states are grouped by value of products; in Table 7, pages 66–69, the states are ranked according to first, second, and third place, by industries (264); in Table 10, pages 70–76, the industries of the various states are ranked first, second, and third, as measured by value of products, etc.

Such a ranking process is indefensible for at least two good reasons, if for no others. First, the criteria upon which the ranking is made are for the most part meaningless or unreliable or both; and second, the form of ranking is without statistical merit. Concerning the former, sufficient has been said above; the unreliability of the latter may conclusively be shown by a single example taken from the Report under consideration. The following tabular statement compiled from Volume VIII, Tables 1 and 2, pages 40–43, and 45–47 respectively, is designed to show for two criteria for ten industries the unreliability of ranking by numerals.

NAME OF INDUSTRIES AND RANKING BY VALUE OF PRODUCT, AND VALUE ADDED BY MANUFACTURER, 1909.

Industry.	Value of Product, 1909.				
	Amount.	Rank of Industry.	Difference.		
			Amount.	Per Cent.	Rank.
Leather tanned, curried and finished....	$327,874,187	18			
Butter, cheese, and condensed milk....	274,557,718	19	$53,316,469	19.42	1
Paper and wood pulp................	267,656,964	20	6,900,754	2.58	1
Automobiles, including bodies and parts	249,202,075	21	18,454,889	7.40	1
Smelting and refining lead............	167,405,650	30	81,796,425	48.86	9
	Value added by Manufacture, 1909.				
Boxes, cigar........................	$4,178,038	164			
Soda water apparatus................	4,113,059	165	64,979	1.58	1
Files...............................	4,095,473	166	17,586	.43	1
Emery and other abrasive wheels......	4,059,351	167	36,122	.89	1
Baskets, rattan, and willow ware......	3,359,948	176	699,403	20.82	9

For value of product, in the instances chosen, a change in rank of 1 is shown to result from an absolute difference, varying from approximately seven millions to fifty-three and one third millions of dollars, or relatively, by a difference ranging from 2.58 per cent. to 19.42 per cent. In one instance a change in rank of 1 requires five eighths as large an amount as is necessary in another case to occasion a change in rank of 9. Similar, although not so startling differences—simply because the items chosen were taken from the upper end of the scale—assigned to the uniform unit—the passage from one to another position in the numerical scale—appear for the other criterion, value added by manufacture. Ranking of states or of industries in such a numerical hierarchy is done only in violation of the elementary truths of statistical methods. What justification, other than political, there is for elaborate ranking of states numerically is far from clear. The same method of stating relative standing is repeated at various other places throughout the three volumes, and unfortunately in many places the numerical positions are restated at considerable length in the text.

A reading of Chapter VIII, Volume VIII, devoted to Expenses, leaves one skeptical of the real worth of the statistics collected under this caption. The figures suffer because of lack of comparability with those of former censuses, and we are constantly advised of their serious limitations when taken absolutely. The treatment of both text and tables, devoted to this subject, is restricted to five and one half pages, and is characterized by the lack of any positive comment as to the real value of the statistics included.

It is unnecessary, and probably out of place, in this review, to comment in detail on the topics treated and the method of treatment in the remaining chapters of this volume. The details relate to character of ownership, size of establishment, persons engaged in manufacturing industries, etc.

Chapter XV is devoted to a "Description of Individual Industries with Principal Statistics for Each," under fourteen headings, namely: Food and Kindred Products, Textiles, Iron and Steel Products, Lumber and its Remanufactures, Leather and its Finished Products, Paper and Printing, Liquor and Beverages, Chemicals and Allied Products, Stone, Clay and Glass Products, Metal and Metal Products other than Iron and Steel, Tobacco Manufacturers, Vehicles for Land Transportation, Railroad Repair Shops, Miscellaneous. In this chapter are given in broad outline the salient facts given in detail in Volume X.

Volume IX comprises a collection of Bulletins previously issued for the various States and Territories. It contains three and one half pages of "Introduction and Definition of Terms" and a treatment for each state under the following general headings: Comparative Summary for 1909, 1904, 1899, by Industries; Detailed Statement for the State by Industries, 1909; Detailed Statement for Cities, 1909. Slight deviations from this general form are made for the District of Columbia, Alaska, Hawaii, and Porto Rico. The data presented are taken from the general schedule for the most part.

Volume X pertains to the principal industries of the country, and is made up of Bulletins separately published. Statistics relating to character of materials used and products manufactured are given in great detail. No especial comment is necessary in addition to those comments made above relative to some of the classes of data collected and published, save that in many respects the suggestions would, in the case of this volume, be emphasized even more strongly.

As to the execution of the work from the standpoint of arrangement of tables, clarity in text analysis, and definiteness in table headings, etc., the Census office is to be commended. These three sturdy volumes are evidences—a little belated, according to a recent critic—of what can be accomplished in the collection, classification, and presentation of a great mass of statistical data. The mere ease with which comparisons can be made may in a certain sense help to explain what we are inclined to look upon as undue refinement in methods of presentation.

A few suggestions on technique may be hazarded. Text and footnote references are almost invariably made by table number only. This is hardly adequate when the tables are distinguished only by Roman and Arabic symbols. The insertion of page references generally would have facilitated the use of the Reports; and the appending of both page and column references to tables, in the reviewer's estimation, would have been a worthy innovation. An enormous saving of expense would have been effected by the expression of all items merely to the nearest thousands. This would in no wise have detracted from the purpose of the figures. Consistency seems to have been sacrificed in the refining process, which required figures—in many respects, and for many inquiries, hardly more than estimates—to be expressed to the nearest dollar in all tables. The three volumes under review are conspicuous for the absence of maps and display of all kinds The maps which are used are those of the "dot"

type, the amount to be expressed being represented by the number and shading of dots. The merits of such a display over that of shading and cross-hatching are not clear. A feature of decided merit would have been the inclusion of a map at the beginning of each volume, on which were indicated the geographical divisions treated, such as Middle Atlantic, East North Central, etc. The divisions are not easily held in mind, and the summary by divisions would have been clearer if such a map had been appended for reference purposes.

The "Census statistics of manufactures are compiled primarily for the purpose of showing the absolute and relative magnitude of the different branches of industry covered, and their growth or decline" (Vol. IX, p. 9). So far as magnitude is reflected by data which primarily involve enumeration the Reports are not without considerable value. For inquiries involving evaluation the Reports do little more, either absolutely or relatively, than to indicate in the most general way the magnitude, growth, or decline of industry. The inclusion of inquiries involving evaluation may politically be necessary: tabulation in detail of the data received is warranted by neither administrative urgency nor statistical merit.

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THE CENSUS OF MINES AND QUARRIES FOR 1909.

The Census of Mines and Quarries for 1909, which was prepared under the immediate supervision of Isaac A. Hourwich and under the general management of Directors E. Dana Durand and Wm. J. Harris, is a much smaller volume than its predecessor, the Census of 1902, the number of pages having been reduced from 1,151 to 369. The reduction in the size of the volume is not accompanied by a corresponding reduction in the quantity of statistics furnished, but is due to the elimination of a large amount of the interesting descriptive material contained in the preceding census. Since changes in mines and methods have not been very striking, it was doubtless unnecessary to revise most of this part of the work and the present volume admirably answers the purpose of bringing forward seven years the figures of 1902.

The recent census follows the plan of the preceding enumeration as regards the principal outline. A new feature, however, is the classification of operators into those doing manual labor in their mines and those not so participating. This is certainly a useful distinction, for the millionaire coal baron has little in common with the operator of an insignificant drift producing a few tons a month for neighborhood use. This census continues the established plan of separating salaried employees from wage-earners. The studies of capital invested, primary horsepower, and expenses of production resemble, in most respects, those made by the last census. However, certain omissions of importance should be noted: The new census fails to give any data concerning capitalization and interest

and dividends paid thereon and also omits all statistics of daily wages. In place of the latter, there has been inserted a classified record of the hours worked per day.

The loss of the statistics of stocks and bonds issued does not seem to be of great moment since the value printed on the face of a stock certificate represents, too often, only the limits of the imagination of the promoters. The amount of interest and dividends paid does, however, furnish one of the best possible sources of information concerning the net returns of the business and it would seem that these statistics might, with profit, have been continued.

In this, as in every other branch of industry, a classification of workmen according to wages received, is a highly useful variety of statistical information, for average wages fail to furnish the details requisite to a study of the earnings of the different strata of laborers.

A new feature of this census which is worthy of attention is the inclusion of statistics concerning the extent and tenure of the land holdings devoted primarily to the mining industry. The tenure is probably even more interesting than the area occupied, for the latter is not necessarily closely related to value or productive power.

The study of the concentration of control of the mining industry has been made more complete by taking into consideration in the classification of operators, the number of wage-earners employed as well as the value of products.

The 1909 volume makes almost no comparisons with the figures for 1902 and those comparisons given in the Abstract of the Census are far from exhaustive. It may, therefore, be worth while to note a few of the more striking changes recorded. During the seven-year interval, the number of mines in the continental United States is shown to have increased from 155,642, to 193,688, a net gain of approximately one fourth while the number of operators was reduced from 46,858 to 23,664 a decrease of almost one half. A closer examination shows, however, that this remarkable contraction did not result from concentration of control but occurred principally in the oil fields and was almost wholly due to the exclusion of some 29,000 representatives of the Standard Oil company who were, in 1902, classed as independent operators.

The number of salaried persons has risen from 40,812 to 46,475, a change of less than one sixth, but the number of wage-earners has increased from 595,366 to 1,086,782, a rise of over four fifths. This change occurred principally in the production of coal, iron, and petroleum. In 1902, the average salaried man received only $1,022 while in 1909 his salary had increased to $1,202. On the contrary, the average wage-earner, in the first period earned $643, while, in the second period, he received but $552. The income of the salaried man has therefore tended to keep pace with rising prices but the wage-earners now receive less per man than when the price level was relatively low This probably does not mean that the same grade of labor is now receiving a lower wage, but that there has been an influx of an army of low-grade foreign labor into the unskilled positions.

During the seven years, the total value of mineral products rose from $796,826,417 to $1,238,410,322, an increase of 55 per cent. This represents an output per person employed of $1,195 in 1902 and of $1,087 in 1909. Thus, despite the rising price level, the value product per worker diminished. A large increase in the use of machinery is indicated by a rise in the horsepower utilized from 2,867,562 to 4,722,879, but even this expansion of 65 per cent. in the use of power failed to keep pace with the number of wage-earners engaged in the industry. On the other hand, the power used declined from 4.8 to 4.3 horsepower per laborer. Both these facts would indicate a growth in the crude utilization of unskilled labor rather than an increase in the percentages of highly skilled machine operators.

Some interesting changes and conditions are revealed by the statistics on concentration of ownership. The small operators still maintain themselves, but the large operators are annexing most of the expansion in the business. In 1902, 84 per cent. of the coal was produced by concerns having a product value at $100,000 or over. In 1909, this same class of concerns extracted 90.2 per cent. of the coal. Firms turning out this same value product of $100,000 or over mined 92.1 per cent. of the iron in 1902 and 97.3 per cent. in 1909. In the mining of precious metals in 1902, 72.9 per cent. was produced by operators of the same class while, in 1909, 84.5 per cent. came from these large producers. In gas and oil production, the opposite tendency is observed for, in the first period, the product of these large scale operators comprised 88.4 per cent. of the total value while, at the last census, concerns of this size controlled but 72.7 per cent. of the entire value of the product. These figures all make it evident, however, that small entrepreneurs, while numerous, play but a very minor rôle indeed in the extraction of minerals from the earth.

As regards the hours of labor, one is impressed with the general prevalence of the ten-hour day in the iron mines, the limestone quarries, and the phosphate beds; of the nine-hour day in the anthracite fields, and of the eight-hour day in most of the other lines of mining.

One might add indefinitely to similar comments on the contents of the volume. Complete individual reports appear for each state and for each of the more important of the mineral products.

While it is manifestly impossible to obtain statistics concerning all the facts which it is desirable to know, there are a few omitted points regarding which it would seem that the public ought to be informed. The previous classification of wage-earners according to daily wages might well have been maintained and should be continued. A question much more difficult to answer, but about which it seems important to be informed, is concerning the actual number of days worked by the average individual miner. Turning to the side of valuation, even rough estimates of the present cost of reproduction of the machinery, buildings, tracks, and timbering in the active workings and of the present value of the mineral deposits themselves would be helpful in order that we might learn something about the total mine value and its division into capital goods and land value.

The total amount paid out in dividends and interest should be recorded from year to year in order that the real profitableness of mining operations to the investor might be ascertained.

On the whole, the work of Mr. Hourwich and his associates is to be highly commended for its compactness, uniformity of tabulation and presentation throughout, its logical form, and its clarity of statement. In all of these respects, this volume, like the others planned by Director Durand and completed by Director Harris, seems to mark a decided step in advance in the presentation of census statistics to the reading public.

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REPORTS ON POPULATION, THIRTEENTH CENSUS OF THE UNITED STATES, 1910.

VOLS. I, II, AND III. WASHINGTON: GOVERNMENT PRINTING OFFICE. 1913.

It would be manifestly impossible in limited space to adequately review this group of volumes, comprising an aggregate of nearly 3,800 pages, which, together with an additional volume on "Occupations" (not here considered) constitute the published material on the single subject of Population, as enumerated in the census of 1910. There are, however, certain features of these reports which call for special consideration. While the subject-matter of these reports, considered as a group, does not differ signally from the subject-matter of the reports on Population of the previous census, the method of presentation of the material is distinctly different.

In 1910, when the method of presentation of the results of the census was under consideration, a press notice was issued by the Bureau of the Census, calling attention to the "Radical and Practical Departure from Previous Census Methods." No one will deny that the method of presentation of the 1910 census returns was at least a "radical" departure from that of the previous census and, while it may be open to question as to whether the departure was a "practical" one, it appears to the writer, who has had occasion to observe the use made of the population reports by the general public, that the method of presentation of the later reports has given more general satisfaction because it has resulted in accomplishing the very purpose for which the change was made, as expressed in the bulletin above referred to, namely, "To simplify and make more accessible the census data, so that they can be readily used, not merely by expert students and statisticians, but by the average citizen." With reference to the method of presenting the population statistics of 1900 it was stated in the bulletin that:

"In the reports of the previous census [1900] practically all the information was arranged with a view to facilitating comparisons between different localities with respect to a given subject, and not with a view to enabling the people of a given locality to ascertain readily all the facts with regard to that locality.

"Thus, the numbers of inhabitants for all the so-called minor civil divisions—townships, villages, etc.—of all the states were presented in one table, the same figures for the incorporated places of all the states in another

table, the various classes of population details regarding all the counties in the United States in another series of tables, etc. This meant that a person who wished to look up the statistics of minor civil divisions, incorporated places and counties for his own state alone had to look in several widely separated places for them. Even a person who desired to find information with regard to his own county alone had to consult a large number of scattered tables.

"In one table, for example, he would find the absolute number of inhabitants for his county side by side with similar figures for every other county in the United States. He would have to go to another table, where again the figures for all the counties of the country appeared, to find the figures distinguishing the population of his county according to color and native and foreign birth. He would have to turn over many pages more before he came to the figures for his county with regard to the country of birth of the foreign born. Still further over he would find the figures for his county regarding males 21 years of age and over; in another place, in fact, in another volume, the figures regarding illiteracy; still elsewhere those regarding the school attendance of the children. In each of these tables the figures for any one county were presented from left to right, the various counties being listed down the side of the page and the subjects across the top.

"The result of this method of presentation was that very few of the inhabitants of any county ever saw or made any use of the statistics regarding that county, except possibly those of the mere number of inhabitants. Similarily, in the 1900 census report, the statistics of any given city or village had to be picked out from many scattered places." . . .

The validity of the above criticism of the method of presenting the population returns of 1900 will be readily recognized by referring to the following summary of the principal captions of the two volumes on population for that census.

REPORTS OF THE TWELFTH CENSUS.

VOLUME I.

GENERAL REPORT AND ANALYSIS. (pp. i-ccxxix.)
- Introduction.
- Population of States and Territories.
- Density of Population.
- Center of Population and its Median Point.
- Population of Counties.
- Population of Incorporated Places.
- Urban Population.
- Rural Population.
- Sex.
- General Nativity.
- Color.
- State or Territory of Birth.
- Country of Birth.
- Foreign Parentage.
- Citizenship and Years in the United States.

MAPS AND PLATES.

GENERAL TABLES (Nos. 1-92) (pp. 1-1006).
- States and Territories.
- Counties.
- Minor Civil Divisions.
- Cities, Towns, Villages and Boroughs.
- Sex, General Nativity and Color.
- State or Territory of Birth.
- Country of Birth.
- Foreign Parentage.
- Citizenship and Years in the United States.

VOLUME II.

GENERAL REPORT AND ANALYSIS. (pp. i-ccxxiii.)
- Elements of the Population.
- Ages.
- Persons of School Age.
- Males of Militia Age.
- Males of Voting Age.
- Conjugal Condition.
- School Attendance.
- Illiteracy.
- Can not speak English.
- Occupations.
- Dwellings and Families.
- Proprietorship of Homes.
- The Territory of Alaska.
- The Territory of Hawaii.
- Appendix—Form of Schedule.

MAPS AND PLATES.

GENERAL TABLES (Nos. 1-115) (pp. 1-754).
- Ages.
- School, Militia and Voting Ages.
- Conjugal Condition.
- School Attendance.
- Illiteracy.
- Can not speak English.
- Occupations.
- Dwellings and Families.
- Proprietorship of Homes.

The following summary of the matter in the 1910 reports has been pre-
pared by selecting, in so far as possible, the same principal captions a
those appearing in the 1900 reports, in order that a direct comparison may
be made between the order of presentation of the material in the respective
reports.

REPORTS OF THE THIRTEENTH CENSUS.

VOLUME I. (pp. 1-1369).

(This volume constitutes the General Report and Analysis.)

SUMMARY OF CHAPTERS.

INTRODUCTION.

- I. Number and Distribution of Inhabitants.
  - Introduction.
  - Population by Divisions and States.
  - Apportionment of Representation.
  - Area and Density of Population.
  - Centre of Population and Median Lines.
  - Urban and Rural Populations.
  - Communities Classified According to Size.
  - Cities and their Suburbs.
  - Population of Individual Cities.
  - Population of Counties of Equivalent Divisions.
  - Principal Tables.
- II. Color or Race, Nativity and Parentage.
- III. Sex Distribution.
- IV. Age Distribution.
- V. Marital Condition.
- VI. State of Birth of the Native Population.
- VII. Country of Birth of the Foreign-Born Population.
- VIII. Country of Origin of the Foreign White Stock.
- IX. Mother Tongue of Foreign White Stock.
- X. Year of Immigration of Foreign-Born Population.
- XI. Voting Age, Militia Age and Naturalization.
- XII. School Attendance.
- XIII. Illiteracy.
- XIV. Inability to Speak English.
- XV. Dwellings and Families.
- XVI. Ownership of Homes.
- App. Form of Schedule.

VOLUME II. (pp. 1-1160).

REPORTS BY STATES.

Alabama to Montana.

(The following is the form of presentation for eac
State and Territory).

Alabama.

CHAPTER I—NUMBER OF INHABITANTS.

Explanatory and Analytical Text and Tables.
Maps.

GENERAL TABLES.

- I. Population of minor civil divisions: 1910
  1900, and 1890.
- II. Population of incorporated places: 1910
  1900, and 1890.

CHAPTER II—COMPOSITION AND CHARACTERISTIC
OF THE POPULATION.

Explanatory and Analytical Text and Tables.
Map.

GENERAL TABLES.

- I. Composition and Characteristics for th
  State and for Counties.
- II. Composition and Characteristics for Cities o
  25,000 or more.
- III. Composition and Characteristics for Cities o
  10,000 to 25,000.
- IV. Composition and Characteristics for place
  of 2,500 to 10,000.
- V. Composition and Characteristics for wards o
  cities of 50,000 or more.
  - Notes regarding changes in boundaries, etc.

Other states are considered in alphabetical orde
the form of presentation being the same as unde
Alabama.

VOLUME III. (pp. 1-1225)

REPORTS BY STATES.

Nebraska to Wyoming. Alaska, Hawaii, Porto Ric
(Same method of consideration as in Vol. II.

On comparing the above summaries or outlines of the reports of the
respective censuses one will observe that the later arrangement provides, in
a single volume, for the general summaries and analyses contained in the
first portion of each of the two volumes of the 1900 census; but the genera
tables giving the information in minute detail with elaborate comparisons
for the minor civil divisions, such as counties and the small cities and towns
are lacking. For students and expert statisticians this lack undoubtedly
works a hardship, rendering it necessary for them, when making a thorough
study of some particular phase of population statistics where comparisons
between such minor civil divisions of different states are required, to compile
the data themselves by assembling the details from the sections devoted to
the several states. But any inconvenience to which those engaged on
special inquiries of this nature may be subjected is far outweighed by the

great convenience which the ordinary citizen enjoys through having immediately accessible in a single volume, in compact form, the principal data for that particular locality in which he may be especially interested.

The adoption of this method of presenting the returns by localities made it possible to carry out the plan, as announced in the press notice, "to publish for each state a bulletin which [would] contain at least the more important figures derived from the population census, both for the state as a whole, and for its counties, cities, and minor civil divisions." Notwithstanding the delay in the publication of a large number of these bulletins—a very prolonged delay in certain instances—it is assuredly true that the public was in possession of those portions of the census returns which are principally in demand, much earlier than would have been the case had the method of presentation of the returns followed that of the preceding census. Furthermore, the advance bulletins were in the form in which they were finally incorporated in the bound reports, thereby rendering unnecessary further composition of those portions of the report.

With reference to the bulk of printed matter in the reports of the two censuses, it should be pointed out that the 1900 population returns were published in *two* volumes, together comprising slightly over 2,200 pages, while the 1910 returns were published in *three* volumes, together comprising about 3,750 pages. In part, this increase was due to some duplication of figures in the general and state tables and, in part, to additional matter, principally text discussion, for the several states not included in the 1900 reports. It was the intention, however, to avoid duplication of the figures for counties and for the smaller cities, and, consequently, we find that information of this character was published only in the state bulletins. On the other hand, the statistics of the several states and larger cities were published in comparative tables in the first volume, or general report, because it was believed that "Persons who have this general interest in the statistics desire to consider the figures for given states and large cities as elements or sections of the nation, rather than as units standing by themselves, and to have them in form convenient for comparison." In order, therefore, to accomplish this purpose of meeting the demand for data for states and the larger cities presented both in comparative form and individually, it was necessary to duplicate the figures of this nature.

It might naturally be supposed that the printing of such a large number of additional pages (about 1,500) would increase the cost of meeting the public demand for the 1910 reports. Such would have been the case were it not for the fact that in a great majority of instances the demand is purely for *local* statistics and can be readily supplied by furnishing a copy of the section pertaining to a particular state under consideration; for example, by supplying a paper-covered bulletin of only 79 pages where one wishes merely the statistics for the State of New York, or one of 46 pages where one wishes merely the statistics for Massachusetts. And even should one wish comparative figures for the several states or larger cities, the demand can be met by supplying in a single volume of less than 600 pages the "Abstract" of the census, which, as described by the Director of the Cen-

sus, contains "in condensed form the principal statistics gathered at the decennial enumeration of 1910 on the subject of population (except occupation statistics), agriculture, manufactures and mining, and gives figures on all subjects for the United States as a whole, and for the different states together with the statistics relating to population and manufactures for the principal cities." This Abstract has been issued in a series of separate editions for each of the several states and territories, each of which edition contains the abstract, as such, together with a supplement containing information in greater detail for the state to which it refers, which embraces al of the census results published concerning that state, its counties, cities and other civil divisions, except as to occupations.

The writer has found that the possession of this abstract with its supple ment for Massachusetts has enabled him to supply information in answe to nearly all of the inquiries relative to population statistics which hav been referred to him by citizens of Massachusetts, in so far as such inquirie are covered by the enumeration in 1910.

While the change in the method of presenting the population statistics and indeed, the other statistics of the census in 1910, does not entirely mee the needs of those who are engaged in the study of a particular subject in which comparisons between the smaller localities of several states are made and while the change of method may have caused some confusion becaus of the necessity, on the part of those who are in the habit of consulting th census reports, of familiarizing themselves with a new method of presenta tion, it is undoubtedly true that never before have the returns of the censu been so accessible to the general public, and when succeeding reports shal have been presented on the plan of the last census the comparability o census returns from period to period will have been greatly facilitated.

ROSWELL F. PHELPS.

RIES, No. 108. (VOL. XIV.) DECEMBER, 1914

UARTERLY PUBLICATIONS OF THE

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AMERICAN STATISTICAL ASSOCIATION FOUNDED 1839

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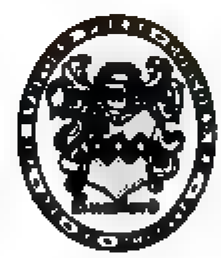

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AMERICAN
STATISTICAL ASSOCIATION

NEW SERIES, No. 108. DECEMBER, 1914.

COÖPERATION BETWEEN ACADEMIC AND OFFICIAL STATISTICIANS.*

By Walter F. Willcox, Ph.D., *Professor of Economics and Statistics, Cornell University.*

After I had gladly accepted the invitation to address you this morning on the subject of coöperation between academic and official statisticians, I was requested to represent the Royal Statistical Society on this anniversary occasion and to convey to you their appreciation of your work in the past and their good wishes for your future. This naturally led me to consider the original connection between the British and the American societies with the idea of making it at least an introduction to my main theme. But the circumstances surrounding the birth of the British society are so little known on this side of the Atlantic and so significant in their bearing upon the origin of our own association that I have decided to state them in detail even at the cost of abbreviating what at first I had planned to say. The two themes are not so unrelated as might at first appear, because in my opinion it is or should be the main function of a statistical society to foster coöperation between academic and governmental statisticians.

The formation of the American Statistical Association was one result of a general interest in the establishment of statistical societies which reached its climax between 1830 and 1840 and may be traced in France, Germany, Italy, and the United States, but was nowhere so strong as in England, where special conditions gave it a notable development. In that country the British Association for the Advancement of Science had been formed in 1831, and two years later it had constituted a statistical section; in the same year, 1833, the Manchester Statistical Society was organized; in 1834 the Statistical Society of London, now the Royal Statistical

*Address at the Seventy-fifth Anniversary Meeting of the American Statistical Association, Boston, Mass., February 14, 1914.

Society, was founded; and before 1840 similar bodies had bee established in Bristol, Glasgow, Liverpool, Belfast, Birming ham, Boston, and possibly New York. All of these associa tions had similar objects and a similar organization and spran from a common impulse. Most of them had an ephemera life; only three of them are still active, two of which, th Royal Statistical Society and the American Statistical Asso ciation, are the oldest national statistical societies in the worl

The development of English statistics has been closel associated with the English Royal Society, the greatest of a scientific associations past or present and the cradle of moder statistics. During the last half of the seventeenth centur and the first forty years of its life, the work of three Fellows o the Royal Society, John Graunt, William Petty, and Edmun Halley, laid the foundations of that political arithmetic whic was later with comparatively little change of content to b rechristened with the German name *statistics*.

Shortly before the societies with which we are now concerne were founded, the Royal Society fell for a time upon evil days dissensions within and attacks without. Grave accusation against the administration were published but led to no in vestigation.* Two parties developed in the society and cam to a trial of numerical strength at the election of 1830, whe the reforming element supported for the presidency the grea mathematician and astronomer, John Herschel, and the con servative element supported the Duke of Sussex. After grea interest had developed and an unprecedented number of vote had been cast, the election resulted by a very narrow margi in favor of the conservative candidate, the Duke of Sussex.

Among Herschel's ardent supporters was Charles Babbage who was more responsible perhaps than any other Englishma for the foundation of the Statistical Society of London. I a book, *On the Decline of Science in England,* published i 1830, Babbage had strongly criticised the constitution of th Royal Society, and at about the same time another membe of the reforming party, David Brewster, suggested "an asso

* "The Society (sc. The Royal Society) has for years been managed by a *party or coterie*. . . . T great object of this, as of all other parties, has been to maintain itself in power, and to divide, so far a could, all the good things amongst its members." Charles Babbage, *Reflections on the Decline of Scien in England* (London, 1830), p. 141

ciation of our nobility, clergy, gentry and philosophers" on a more democratic basis. A year after the defeat of the reforming element in the Royal Society, this suggestion of Brewster's bore fruit in the organization of the British Association for the Advancement of Science. It was avowedly an imitation of the Society of German Naturalists and Physicians, which had been formed in 1822 in execution of a suggestion from Oken and which a few years later had gained great prestige from the judicious support of the kings of Bavaria and Prussia and the reputation of its president, the most distinguished of living scientists, Alexander von Humboldt. No doubt the spirit of reform which found expression in the continental revolutions of 1830 and the English reform bill of 1832 was a potent influence in support of the new movement out of which the British Association sprang.

Another factor contributed directly and powerfully to the early recognition of statistics by the British Association. During the decade of which I am speaking Quetelet was probably the most widely known and was rapidly becoming the most distinguished of living statisticians. He had published his first essay in this field in 1826 and in various papers printed during the following years he had shown the regularity with which crimes occurred in different areas and recurred in successive years, and had thus laid the basis not only for what is sometimes called moral statistics, but also for that general view of social life and action which at first he called social mechanics and later social physics. In 1833 Quetelet went to England to attend the Cambridge meeting of the British Association* and carried with him a budget of statistical facts for which the organization of the meeting could provide no place.† This difficulty led his friend, Charles Babbage, one of the three trustees of the new Association, to suggest the formation of a new section on statistics, and one was hastily improvised with Babbage as chairman but without the usual authorization of the Central Committee. In explanation of this procedure, the president of the Association‡

*British Association, *Reports*, III (1833), 484.

†Wm. Farr in *Journal of the Statistical Society*, XXXIV, (1871) 412.

‡Rev. Adam Sedgwick, professor of geology at Cambridge University, and not William Whewell, as one authority has it.

in his concluding address said that, in addition to the regul five sections, "another had come into operation, the obje of which was to promote *statistical* inquiries. It had originat with some distinguished philosophers, but could not be r garded as a legitimate branch of the Association till it h received the recognition of the governing body; there cou be little doubt, however, that the new Section would obta the sanction of the General Committee with some limitati perhaps of the specific objects of inquiry."* The sancti and the limitation thus foreshadowed found expression wh the General Committee approved the formation of a Statistic Section and resolved "that the inquiries of this Section shou be restricted to those classes of facts relating to communiti of men *which are capable of being expressed by numbers, a which promise, when sufficiently multiplied, to indicate gene laws.*"†

This limitation was apparently designed to prevent t statistical section from being led astray into the speculatio of economics and the controversies of politics.‡ It was direct, although probably an unintentioned challenge Quetelet's opinion. Four years before he had writte "Among the data of statistics are some which can be express in figures and others which cannot. To use only one of the kinds of data is to see only one side of statistics."§ Natural enough, Quetelet considered that the resolution of the Gener Committee took "too limited a view of the functions a objects of statistical inquiry"|| and he suggested to Babba the organization of a separate statistical society. The su gestion was adopted and the Statistical Society of Londo formed in 1834.¶

*British Assn., *Reports*, III (1833), xxviii.

†British Assn., *Reports*, III (1833), XXXVII. The italics are in the original.

‡Intern. Stat. Institute, *Bulletin*, I, pts. i and ii, (1886) 41.

§A. Quetelet, *Recherches statistiques sur le royaume des Pays-Bas*, (1829), Introduction, p. iv, in M *moires de l'Académie de Belgique*, V. Compare Quetelet's definition of statistics, "The representatio a State at a given point of time," quoted in Royal Stat. Soc., *Journal*, Jubilee vol., 8.

||Mouat, in Royal Stat. Soc., *Journal*, Jubilee vol., 15.

¶Fifty years later the same antagonism of opinion regarding the scope of statistics was still acute. the Jubilee meeting held to commemorate the fiftieth anniversary of the founding of the Statistical Soc of London, the president in his opening address proposed as a definition of statistics "the science wh treats of the structure of human society" and rejected the narrower definition "the science of social l expressed in numbers." *Idem*, 8.

At the same period and as a result of the same movement, initial steps were taken towards organizing at least two American statistical societies, the New York Statistical Society and the American Statistical Association. The New York society was the earlier, having been incorporated in 1836 and its charter amended in 1839. It was frankly modelled upon the Statistical Society of London.* Its original charter provided for a capital stock of $50,000 and that the society should commence operations when the full amount had been subscribed and $5,000 paid in. Three years later the act was amended by allowing the society to commence operations immediately, but I have found no record that it did so.

The beginnings of the American Statistical Association are shrouded in obscurity. No direct connection between it and the Statistical Society of London has been demonstrated. At the meeting of this Association six years ago President Wright said: Whether the founding of the Statistical Society of London "inspired the organization of this Association, I cannot say but it is safe to assume that this was the case."† That judgment seems to me warranted by the evidence. The sequence in time, the similarity in name and in form of organization, the use by our society at the start of the English term *Fellow* instead of the then usual American term *member* are straws suggesting but in no wise proving the connection. In its Annual Report made in 1842 the Council of the Statistical Society of London wrote: "The Council . . . are much gratified in stating that the Constitution of the Society has served as a model for the American Statistical Association which has been established at Boston, United States."‡ Perhaps stronger evidence in favor of that conclusion may be found in the statement regarding our Association's field and aim which it published in 1840 and republished three years later as the preface to the first volume of its *Collections*. The opening and the closing sentences of that statement are quo-

*"In the important city of New York a Statistical Society has been appointed and established by the Legislature of that State; and the Council feel gratified in reporting that the principles and regulations which form its Constitution have been avowedly adopted from those of the Statistical Society of London." Stat. Soc. of London, *Journal*, I (1838), 8. See also, Silliman's *Am. Journal of Science and Arts*, XXXII (1837), 202. New York Laws 1836: Chap. 495, and 1839: Chap. 193.

†Am. Stat. Assn., *Quart. Pub.*, XI (1908–09), 1.

‡Stat. Soc., *Journal*, V (1842), 89.

tations from the first few pages of the first volume of the *Jour-nal of the Statistical Society of London* and yet to the carele reader that fact would not be apparent. No quotation mark are used about the first sentence and only an indefinite refer-ence is given in the footnote. Although quotation marks ar used about the last sentence, no other reference to the sourc is made than the introductory words, "In the language of kindred institution." Can the writer have thought it inad-visable to emphasize the extent of his obligation to an Englis society?

However that may be, the "Address put forth by the Asso-ciation at the period of its first establishment in the year 1840' differs in one important respect from the corresponding state ments in the *Journal of the Statistical Society of London.* I draws heavily upon some unidentified German source for fact regarding the history of statistics in Germany and Sweden and the position of that subject at the time our Associatio was organized not only in those countries but also in Franc and Italy, and it intersperses brief references to the mai writers on statistics. The German cast of this part of th "Address" and its seemingly deliberate omission of any refer ence to the English writers on Political Arithmetic, who wer mentioned by its English predecessor, show that the write regarded the statistics which our society was to cultivate a the creation mainly of German scholars. Looking back fro the vantage ground reached after seventy-five years of history it seems fair to say that in this respect the "Address" pu forth by our founders was true to the facts.

For the historians of statistics are now well agreed that th study we cultivate sprang from two main roots, one in th German universities, the other in English studies of politica arithmetic. The former developed, under the name of sta tistics, a descriptive political science almost devoid of figure but systematic and suitable for presentation in academic lec tures or treatises. The latter developed, under the name o political arithmetic, a series of fragmentary and disconnecte studies of available numerical data. Between 1730 and 183 the English ideas slowly penetrated Germany, introducin numerical data and gaining especially from Süssmilch

systematic, orderly presentation quite alien to their original form.

During the same period the German name *statistics* spread to England and this country. Probably the first writer to make it at home in English was Sir John Sinclair whose voluminous *Statistical Account of Scotland* exercised a traceable influence on both sides of the Atlantic. He wrote in 1798: "In the course of a very extensive tour through the northern parts of Europe which I happened to take in 1786 I found that in Germany they were engaged in a species of political inquiry to which they had given the name of Statistics and . . . as I thought that a new word might attract more public attention I resolved on adopting it and I hope that it is now completely naturalized."* The earliest occurrence of *statistics* in English was in 1770 and thus more than fifteen years before Sinclair, when Dr. Hooker published a translation of Bielfeld's *Elements of Universal Erudition.* One of its chapters is entitled Statistics and contains a definition of the subject as "The science that teaches us what is the political arrangement of all the modern states of the known world."† With this German name came also some of the German fondness for system and for breadth of treatment, and all these factors contributed to the establishment of English and American statistical societies. The statistics which were thus to be studied came much nearer to the German prototype than to the English political arithmetic.

This sketch of the origin of English and American statistical societies suggests, though I would not claim that it establishes, certain conclusions which a more thorough study of their history would probably substantiate.

1. Local statistical societies have been more short-lived than national statistical societies. Of the numerous English local societies only that of Manchester survives. We may regard our society's ambitious name as having been favorable to its permanence. Had it called itself the Boston Statistical Society or the Massachusetts Statistical Society, its chance of survival would have been less.

*Sinclair, *Stat. Account of Scotland*, XX, xiii.

†Hooker's, Bielfeld, *Elements of Universal Erudition*, III, Chap. XIII, 269.

2. Statistical societies established at the capital of a countr have had a better opportunity to grow than similar societie established elsewhere. The Paris Statistical Society has lon since outstripped the older Grenoble Statistical Society an has become in fact, though not in name, the statistical societ of France; the statistical society of London, in recognition o its actual status and its fifty years of work was privileged i 1887 to change its name to The Royal Statistical Society; th Frankfort Association for Geography and Statistics, thoug founded in 1836, is of secondary importance.

3. The modern tendency is to make statistical societie peripatetic. This is almost necessarily true of internationa organizations like the Congresses of Statistics, the Congresse of Hygiene and Demography, and the International Statistica Institute; it is true of all three German statistical associations namely, the Association of Imperial and State Governmenta Statisticians, the Union of German Municipal Statistician and the German Statistical Society; of recent years our ow Association has amended its charter with this object in view

4. It is often wise for a statistical society to affiliate temporarily or permanently with other scientific societies. Bu its best connections lie with societies devoted to economics political science, and law rather than with the natural o physical sciences. The economic and statistical sections o the British Association for the Advancement of Science an of the American Association for the Advancement of Scienc have had a checkered career and have at times been viewe askance by the parent organizations. The contrast betwee the origin of the British Statistical Society in 1834 as a offshoot from the statistical section of the British Associatio and the origin of the German Statistical Society in 1910 as section of the German Sociological Society illustrates th change in this particular in seventy-five years. Hence ou tendency to hold our recent annual meetings in connectio with those of the economic, sociological, and historical associations seems in accord with the general trend.

5. A local statistical society exerts a strong influence i creating or maintaining sound work in statistics. When on thinks of the pioneer work of Shattuck, Jarvis, Walker,

ott, and Dike, to mention only the dead, and of rs during which the censuses and the registration Massachusetts have trained men or furnished ther states and the country, one cannot but feel rican Statistical Association with its headquarters has materially aided in giving Massachusetts its ion of leadership in American statistics.

in end of the earlier statistical societies was the f statistics in the sense of Quetelet's early defini- presentation of a State at a given point of time,"* words, a description of a country or locality far as possible in numerical terms, and, in pursuit f the needed material did not exist, the statistical nt to gather it by independent inquiry. Thus, nnual Report of the Council of the Statistical ondon describes the work of the following com- A committee to inquire into the state of educa- on; (2) A committee to gather statistics of strikes tions in the United Kingdom; (3) A committee atistics regarding population, births, marriages, (4) A committee to gather statistics regarding laborious character of such work and the ten- government to take it over were important in- ling to limit the activities and shorten the days eties.

in end of statistical societies like ours is or should a center around which official statisticians and isticians may meet and fraternize. There has me danger that these two groups might work at es, the producer of statistics resenting the criti- ate students who have sometimes been ignorant to remain ignorant of the real difficulties besetting the official and whose criticisms in consequence nintelligent or unjust, the user of statistics con- output of an office because it does not meet his isfy his special requirements. Statistics, unlike r sociology, is an art, a profession, as well as a is often, perhaps usually, guided quite as much by

n W. Rawson in Stat. Soc., Journal, Jubilee vol., p. 8.

administrative as by scientific aims. Not that the truth i wrested or concealed, but that the whole truth can never b ascertained and that part which is presented must be deter mined mainly by the needs of administration. To further thi end the meetings of a statistical society are far more importan than its publications.

This review of the past history and present condition c statistical societies naturally leads to the question of coöpera tion between academic and official statisticians. Most of th larger American institutions offering statistical courses la stress upon laboratory practice. The real laboratory is a adjacent statistical office, just as the real laboratory for medical school is a hospital, and university courses in statistic on the practical side are likely to be somewhat dilettante unt both university course and statistical office are so modifie that they can work together to mutual advantage. When university offering a course in statistics is situated in or nea a great city or a state capital, it should be or become possibl for the teacher to present and interpret the statistics of tha city or state. This could be done to greater advantage, if th teacher of statistics were officially connected with the publi office or the government statistician were given a universit appointment. Such relations have been common in conti nental countries. I need only mention Dieterici, Engel an Boeckh at Berlin, Hermann and von Mayr at Munich an Neumann-Spallart, Inama-Sternegg, von Juraschek an Mischler at Vienna. The importance of this suggestion lead me to quote a few sentences regarding the statistical seminar of Engel at Berlin and of Inama at Vienna. Of the semina which Engel started at Berlin after he had been made Directo of the Prussian Statistical Bureau Blenck wrote:

"In November, 1862, he opened a statistical seminar i which the theory and technique of statistics and the inter relations between statistics, administration and legislatio were investigated and statistical theses written in connectio with the current work of the Bureau. This seminar prove of great educational value to many young men who after wards devoted themselves to administration or were appointe to chairs for political science and statistics in the Germa

Among these were Meyer, Oncken, Schönberg, d, Brentano, Cohn and Elster. High officials, the legislature, or persons connected with foreign Berlin were among the regular attendants."*

in the 70's there had been a seminar in connection ntral Statistical Commission. Inama transferred iversity. It rendered the double service of train- y students in the science of statistics and utilising a method of gaining scientific knowledge. Under lership from 1882 to 1905 it gained an international nd trained a great number of distinguished statis- most all the professorships of statistics in Austrian are held by men trained in it and many important originated there. In this way a statistical school up, extending and continuing the ideas of the

ce that such work is needed I may also quote a dopted at the ninth and last International Sta- gress: "The Congress believes that the teaching l statistics at the universities should be supported conferences and that to secure this result statisti- should be formed in connection with departments and statistical bureaus should, if possible, establish with teachers of statistics, although entire inde- ould be assured to each side."‡

this sort, I believe, is more needed in the United y than any other line of statistical development. nearest approach to it that we have ever had was of young men who gathered around Carroll D. ng the twenty years when he was at the head of Bureau or Department of Labor. Since the of Mr. Wright, no one in Washington has done s description. Neither in the Census Bureau nor e smaller statistical offices is there an opportunity ining in statistics which would qualify one to rise important statistical positions there or elsewhere.

d translation from Intern. Stat. Inst., *Bulletin*, X, pt. ii (1897), 141.
d translation from von Juraschek in *Stat. Monatschrift*, XXXII (1906), 12.
in *All. Stat. Archiv*, I (1890-91), 16, footnote.

This is the more important because the rapid development o public health work and of vital statistics as tributary to it creating a demand for men trained in demography, whic neither our bureaus nor our universities are doing much t fill. It might be said in reply that even the highest positior are not yet thought to demand professional training or hel on a secure and permanent tenure. But the objection is no unanswerable. Is not the true relation one of interdepend ence? Is not the lack of a public demand for profession standards among official statisticians due in the main t public ignorance of the added significance and value a we trained man can give to statistical inquiries and their result If so, are not the men best able to create this demand th private scholars and teachers of statistics? Is not the be method for them to follow that of constructive criticism o current statistical inquiries and interpretation of their resul beyond the point at which they are left by the office whic issues them?

In many university courses in statistics, laboratory exe cises are included, but there is apparently no agreemen regarding the scope and character of these exercises. In m opinion they should, if possible, be given definiteness an practical significance by being used to criticise or interpr the statistical results obtained in communities in which th class is interested. This might be the university community the town or city in which the university is located or th student lives, or even the state as a whole. I cannot but fe that there may be some danger of turning the attention o the class too exclusively either to graphic methods of repre senting results or to mathematical methods of determinin the exact degree of correlation. Doubtless each of these ha a place and an important place in a course of statistics, bu neither strikes at the spot in which most errors are found namely, the original returns. In studying tuberculosis, fo example, to make elaborate corrections for differences in th age and sex distribution of the population and of decedent in successive periods and to pass in silence the question of th comparative accuracy of diagnosis at the different dates is t strain at a gnat and then swallow a camel. For a large majo

ical errors are those which creep into the raw cannot be eliminated by any refinements of analysis or any skill in graphic representation. tention on these field errors has the incidental bringing home to the student as nothing else difficulties before the official statistician and of mutual understanding and sympathy between officials so necessary for hearty, continuous

t in my opinion that the best service the Ameri- l Association can render to the progress of sta- ringing together for purposes of friendly discus- eration the producers and consumers of statistics, the future policy of the Association might be der better to secure that end. Would it be well the experiment of establishing standing com- hose which did good work in the early years of Statistical Society? Perhaps committees on on state work and on municipal work might be haps a committee on the teaching of statistics anized, or a committee on infant mortality. society should not follow the position of the ociological societies and confine its work in the s and discussions not ripening into recommenda- ain duty is to improve Federal, state, and munic- in the United States, and this we should hope by the example of our members but also by the mal recommendations.

THE ECONOMIC PROGRESS OF THE UNITED STAT DURING THE LAST SEVENTY-FIVE YEARS.*

BY FREDERICK L. HOFFMAN, LL.D.

The present discussion is limited to verifiable evidences
our national progress since 1840. The period of time co
sidered does not always constitute an exact three quarters
a century. For many factors of our national progress t
statistical data are not available for so long a period of yea
For the principal elements the rate of progress has been dete
mined for the seventy years commencing with 1840, or t
year following the establishment of the American Statistic
Association, and ending with the year 1910, or the date of t
last federal census. Preliminary to the taking of the cens
of 1840, a most interesting volume on "The Principles
Statistical Inquiry as Illustrated in Proposals for Uniting
Examination into the Resources of the United States with t
Census to be Taken in 1840" was published in 1839. T
author of this work was Archibald Russell, of whom little
known at the present time, but who rendered a distinct servi
to the nation, for, as said by Carroll D. Wright in his Histo
of the United States Census, "The census of 1840 may be sa
to mark the beginning of the concerted effort to make t
decennial enumeration the instrument for ascertaining som
thing beyond the mere number of persons of each sex and
various ages, constituting each of the three great divisions
the population. (That is, white persons and colored perso
whether slaves or freedmen.)" President Van Buren in h
second annual message, dated December 8, 1838, had made t
suggestion as to "whether the scope of the measure might n
be usefully extended by causing it to embrace authen
statistical returns of the great interests especially entrusted
or necessarily affected by the legislation of Congress."
memorial was presented by the American Statistical Ass
ciation to Congress in 1843, in which it was set forth th

* Address at the Seventy-fifth Anniversary Meeting of the American Statistical Association, Bo
Mass., February 14, 1914.

d gross errors had been discovered in the printed the Sixth Census, but that the committee of the appointed to investigate the matter and report Congress, not having reliable data with which to ll the details of the census, confined their investi- the reports respecting education, nosology, and nts. The memorial of the association is given in use Reports, 28th Congress, First Session, Vol. III, The treatise by Russell, no doubt, had much to do enlarged plan and scope of the census of 1840, in- aside from a discussion of the general principles of l inquiry, a consideration in detail of the statistics nd manufactures, agriculture, occupations, place of vital statistics, crime, pauperism, education, the axation, as well as observations on the agents to be l in procuring accurate statistical information. Mr. connection with the census of 1840 is not made clear, nly name mentioned in Wright's History of the Census of William A. Weaver, of Virginia, who served as ending clerk in the Department of State until March .

g the intervening seventy years the United States has become a truly colossal institution. Additional an equally enormous amount of statistical knowledge g the social and economic condition of the people is vailable through the statistical offices of the several nd municipalities and private institutions and corpo- It would be utterly impossible, within the limitations ddress, to even briefly discuss all of the essential factors ave conditioned the moral, physical, and material of the American people since the establishment of the n Statistical Association in 1839. For the present therefore, the discussion will be limited to about the an and scope as the treatise by Russell in 1839, but d, as far as necessary, to present a comparative out- ne salient facts of practical value at the present time. I take up the statistical facts of the discussion, it be out of place to refer very briefly to some of the vestigations made to ascertain and disclose the prog-

ress of the United States. The term "progress" is used the generally accepted sense of the word. "Progress," sa Arnold Toynbee, "comes chiefly from without; it is extern pressure which forces men to exert themselves, but," as l observes subsequently, "competition may produce wealt without producing well-being," and it is, therefore, necessar to keep at all times in mind the possibility of erroneous inte pretation of the mere facts which emphasize our numeric or material advance. At the same time, for practical purpos there is no other convenient measure of our human evolutic from a primitive condition of society to civilization. Tenc Coxe, as early as 1794, published his "View of the Unite States of America," illustrating by reference to authent documents "the progress and present state of civil and religiou liberty, population, agriculture, exports and imports, fisherie navigation, ship-building, manufactures, and general in provement." The term "progress," as used in this treatis implies primarily the material progress of the nation as tl prerequisite for its social, intellectual, and spiritual advanc An interesting statistical manual entitled "Economica," b Samuel Blodget, was published in 1810. This also is pract cally a treatise on the material growth of the nation in all th essentials which constitute the evidences of a country i process of development from the crude conditions of origin settlement to that of civilized well-being. This work is c special value as illustrating some of the earliest references t Franklin's speculations on population, the utility of statistic of births and deaths, and, finally, the number of insuranc companies, the amount of their capital, the variation c money as expressed in wages, and the price of wheat, and finally, the number of stockholders of banks, insurance com panies, turnpikes, etc.

The next treatise on the progress of the country was pub lished in 1817 by Timothy Pitkin, entitled "A Statistica Review of the Commerce of the United States of America i connection with Agriculture and Manufactures and an Accoun of the Public Debt, Revenue, and Expenditures." Following this work there was published the elaborate Statistical Annals embracing views of the population, commerce, navigation

olic lands, post-office establishments, revenues, f the United States of America, by Adam Seybert, is work contains some very interesting obser- erning population, the growth of commerce, the of the military establishments, list of pensioners nd navy, remarks on the mortality of the United leath rate of cities, comparative statistics for finally, a table exhibiting the expectation of life Philadelphia, etc.

these, I can only mention Bristed's treatise on rces of the United States," published in 1818; ew of the United States," published in 1828; rogress of the United States in Population, in Fifty Years," published in 1843; MacGregor's n "The Progress of America," published, in two 847; Seaman's essay on "The Progress of Nations n, Productive Industry, Wealth and Population," 1863; Lossing's memorial volume on "The ntenary; or a History of the Progress of the Re- United States during the First One Hundred Existence"; and, finally, Gannett's work on g of a Nation, its Growth, Present Condition and with a forecast of the future, published in 1894. e authorities construe the progress of the nation uivalent of its measurable advance by means of he direction of an increase in numbers, commerce, and last, not least, longevity. The term "prog- ed by these writers of the highest authority, constant upward tendency towards the ideal of er share of individual material prosperity as the the largest attainable degree of human happiness. s, shorter hours of labor, a lessened cost of pro- reased opportunities for travel and recreation, ffrage—all are measurable by statistics, and nd conclusively by statistics alone. Progress in vays means social *improvement*, though obviously nber of conditions which affect human well-being happiness are at all times subject to a variable ange. Reviewing the world's progress from this

point of view, as measured by statistical evidence for the la seventy-five years, there can be no question of doubt but tha broadly considered, the world at large and in all its parts h enormously advanced, but nowhere has the rate of growth all the essentials which constitute the material well-being the people been greater than in the United States of Americ

In the sense of these definitions and observations it wou seem, also, Prof. W. J. Ashley, Dean of the Faculty of Con merce and Chairman of the Social Study Committee of t University of Birmingham, and one whose authority no o will question, construes the term "Progress" in the Year Bo of Social Progress for 1913–14. He observes that "It is unmistakable trait of our period that there is practically difference of opinion as to what constitutes progress. *In provement in the economic condition of the body of the people* in the forefront of our attention: the touchstone we unco sciously apply to every social effort and proposal—rightly wrongly, the typical men and women of today, who are ale and public-spirited, have before their mind's eye, as an obviou goal of endeavor, the vision of the whole people fed ar housed sufficiently well to enable them, if they choose, to lea healthy and pleasant lives, freed from demoralizing irreg larities of employment; with sufficient leisure for fami affection and sufficient education for civic duties." Th comprehensive and readily intelligible definition of progre underlies and limits the present discussion, which is concerne almost exclusively with what Walter Bagehot has proper called "verifiable progress," in the true and incontrovertibl common, every-day acceptance of the term.

The gross area of the continental United States increas from 1,792,000 square miles in 1840, by acquisition, concessio or purchase, to 3,027,000 square miles in 1914, and, includir Alaska and insular possessions, to 3,743,000 square mile The gross area of the continental United States now excee the combined area of the United Kingdom, Germany, Austri Hungary, France, Spain, Italy, Scandinavia, Greece, t Balkan States, Egypt, Japan, and Mexico.

The total population in 1840 was 17,069,000. For 191 our continental population is conservatively estimated

). The rate of increase during the intervening our years has been 478 per cent. The present n exceeds the combined populations of the United and the empire of Austria-Hungary.

ite population has increased from 14,196,000 in 1840 000 (estimated) for 1914. There has, therefore, been increase during the intervening seventy-four years 000, equivalent to a rate of growth of 6.95 per cent. m. The estimated corresponding growth of con- Europe during the same period of time was only 1.2 per annum.

gro population of the United States increased from in 1840 to 10,225,000 (estimated) for 1914. The rate was, therefore, 255.9 per cent. for the intervening contrast to a growth of 514.3 per cent. for the white n, which, of course, includes a substantial increase gration.

mber of Indians in 1840 is partly a matter of con- It is doubtful whether the number exceeded 300,000. conservative estimate placed the number at 278,000, 890 at 248,000. For 1914, largely on the basis of umerations, the number of Indians is conservatively at 277,000. A large number of persons of Indian ure are considered white, and as such enumerated ensus. In contrast, even the slightest degree of gro intermixture warrants, by present usage, the in- such among the negroes.

mber of Chinese in 1840 was very small. By 1865 er was 49,000, which by 1890 had increased to 107,- consequence of Chinese exclusion laws, the number ally diminished, being estimated for 1914 at 64,000. rast, there has been a rapid increase in the Japanese n. In 1890 the Japanese numbered only 2,039, estimated Japanese population of 91,289 for 1914.

eign-born white population was not ascertained pre- 1850. In that year the census returned 2,240,000, 1910 had increased to 13,345,000, or 495.8 per cent. responding increase in the native white population 17,312,000 in 1850 to 68,386,000 in 1910, or 295

per cent. The native white population, however, includes considerable number of native-born of foreign or mixed pa entage. The number of such persons was not enumerat previous to 1870. In 1910 the number of persons of nati parentage was 49,488,000; the native-born of foreign parenta was 12,916,000; and the number of native-born of mix parentage, 5,981,000. The tendency of the population towards a more varied composition, largely because of t enormous foreign immigration during the last forty yea No thorough analysis of the population problem has be made and it is therefore impossible to say with absolu accuracy whether there is a pronounced tendency towar gradual and complete assimilation of the foreign-born w the native-born of native parents. The indications are th this is not the case.*

During the twenty-five years ending with 1864, the numb of immigrants arriving in the United States was 4,949,0 During the twenty-five years ending with 1889 the numb arriving was 9,365,000. During the twenty-one years endi with 1912 the number arriving was 14,655,000. The comp nent parts of the immigration during the last quarter of century differ fundamentally from those of the influx previo to 1890. Of the total foreign-born population of the Unit States in 1900, 17.7 per cent. had its origin in southern a eastern Europe. In 1910 the corresponding percentage this population was 37.4. Earlier returns would exhibit even more striking contrast.

In 1840 the density of population per square mile was 9 which by 1865 had increased to 11.8, and by 1914 to 33 The corresponding present density of the German Empire 310, of France, 191; of Austria-Hungary, 196; of the Unit Kingdom, 374; and of Belgium, 659. Even if the prese growth of the American population continues during the ne fifty years as it has in the recent past, the then attained de sity will be only one fifth of the present density of the Germ Empire.

* An immense amount of information on the subject of immigration and its social and eco aspects has been published in the forty-two volumes of the report of the United States Immig Commission, Washington, D. C., 1911.

0 about 8.5 per cent. of the population lived in cities population or over. By 1870 the proportion of urban ion had increased to 20.9 per cent., and by 1910 to r cent. The tendency of the country is, therefore, ly towards increased urbanization. Including local- ving from twenty-five hundred to eight thousand ion, the total urban population of the United States was 42,623,000, or 46.3 per cent. of the aggregate, 29.5 per cent. in 1880. During the last decade the ion of urban territory increased 34.8 per cent., against ase of only 11.2 per cent. in the rural territory. Dur- last ten years the rural population actually diminished Hampshire, Vermont, Ohio, Indiana, Iowa, and Mis- In all of these states the urban population increased ably. The total number of cities in the United States with eight thousand inhabitants and over was 786, only 44 in 1840.

umber of farms in 1850 (there being no earlier returns) 49,073. By 1910 the number had increased to 6,361,- he amount of acreage in improved farm lands increased 3,032,000 in 1850 to 478,452,000 in 1910. During e period of sixty years, the average acreage per farm ned from 202 to 138 acres, but the percentage of total a in farms increased from 15.6 in 1850 to 46.2 in 1910. lue of farm property increased from $3,967,000,000 to $40,991,000,000 in 1910. The average value of erty per farm, which in 1850 was only $2,738, increased to $6,444, and the average value of all property per land in farms increased from $13.51 to $46.64. Con- from another point of view, it may be said that against ease in population during the last sixty years of 297 t., the number of farms has increased 339 per cent.; ount of improved land in farms, 323 per cent.; and the f farm property, 933 per cent.

g the last twenty years (there being no earlier data) portion of farms free from mortgage decreased from cent. in 1890 to 66.4 per cent. in 1910; and the ratio to farm value decreased from 35.5 per cent. to 27.3

per cent. There was a corresponding increase in the avera equity per farm, from $2,220 in 1890 to $4,574 in 1910.

The amount of irrigated farm acreage increased fro 3,631,000 acres in 1889 to 13,738,000 in 1909.

The corn crop of the United States increased from 377,00 000 bushels in 1840 to 3,124,000,000 in 1912, or 729 per cen the wheat crop increased during the same period from 84,00 000 bushels in 1840 to 730,000,000 in 1912, or 793 per cen and the wool-clip increased from 35,000,000 pounds in 18 to 304,000,000 in 1912, or 769 per cent. The correspondi increase in the sugar crop was from 120,000,000 pounds 1840 to 1,922,000,000 pounds in 1912, or 1502 per cent. a the cotton crop increased from 1,347,000 bales in 1840 14,295,000 bales in 1912, or 961 per cent.

The production of gold in 1840 was estimated at $11,000,0 By 1880 this had increased to $36,000,000, and by 1912 $91,000,000. The production of coal in 1840 was only 1,84 000 tons; by 1880 the production had increased to 63,000,0 tons; and by 1912 to 477,000,000 tons. The correspondi increase in the production of copper was from 100 tons 1840 to 27,000 tons in 1880, and 557,000 tons in 19 There was no recorded cement production in 1840, and 1880 the amount had reached only 2,000,000 barrels, wh by 1912 had increased to 83,000,000 barrels. There was a no recorded petroleum production in 1840, the earliest retu being for the year 1859. By 1880 the production had reach 1,000,000,000 gallons; and by 1912, 9,328,000,000 gallons. T pig iron production amounted to only 286,000 tons in 18 and 3,335,000 tons in 1880, but by 1912 the production h reached nearly 30,000,000 tons. Corresponding gains w made in the production of practically all the other importa mineral resources.

The census of 1850 was the first to present approximat complete statistical data regarding the manufacturing ind tries of the country. The information collected was for t year 1849, and subsequently thereto corresponding inform tion has been secured by census enumerations. The numb of manufacturing establishments, according to the census 1850, was 123,025, and according to the census of 1910, 268,4

definition of a factory, however, was changed in
at an exact comparison is not possible. The num-
ge-earners employed in manufacturing industries
957,000, which by 1909 had increased to 6,615,000,
er cent. The amount of wages paid increased
same period of time from $236,000,000 to $3,427,-
1352.1 per cent.; and the value of the product
rom $1,019,000,000 in 1849 to $20,672,000,000 in
28.7 per cent. It is regrettable that the statistical
d not be strictly comparable, but the foregoing
approximately measures the remarkable progress
ufacturing industries during the last sixty years.
istics of occupations by age and sex are not yet
or the census of 1910. It is possible, however, to
statistics for manufacturing industries which indi-
gressive decline in the proportion of child-labor,
under sixteen years of age. In 1899 the proportion
yed was 3.4 per cent.; in 1904, 2.9 per cent.; and
4 per cent. These statistics are incontrovertible
hat, regardless of a rapidly expanding interest in
res, the relative number of young persons employed
declined, for during the same period of time the
male wage-earners increased from 3,632,000 in
63,000 in 1909, or 42.2 per cent.; and the number
wage-earners increased from 918,000 in 1899 to
n 1909, or 40.5 per cent. The number of persons
en years of age employed in manufacturing indus-
ned almost the same, or 161,276 in 1899, against
1909. There can be no question of doubt that if
ssible to carry these statistics further back, to the
nsus periods, an even more gratifying reduction in
rtion of child-labor in manufacturing industries
hown. These conclusions, of course, do not apply
d-labor problem at large, but only to child-labor in
ring industries.

nd hours of labor can only be very briefly discussed,
ccount of the paucity of data and partly because
nical difficulties of the subject. Data presented in
of the Senate Finance Committee, published in

1893, on wholesale prices and wages indicate that the relat wages in gold, in all occupations considered, changed fron rated average, according to importance, of 82.5 in 1840 to in 1860, and 168.6 in 1891. As observed by the Committ "From a consideration of the foregoing data, it becon evident that there was a gradual advance in wages from 1 to 1860, and since that date the advance has been less regu but more rapid. The period from 1875 to 1880 was mar by a standstill, but since then the advance has been cont uous." Since 1890 a number of investigations have been m by the Bureau of Labor Statistics, all of which conclusiv show that there has been a further and substantial advance the rate of wages paid in the principal industries. For il tration, in the boot and shoe industries, relatively, wa increased from 98.5 in 1890 to 132.8 in 1912, the period 1890 being taken as one hundred. During the same period r tively nominal full-time hours per week diminished fr 100.3 in 1890 to 93.9 in 1912. In other words, the relat wages were highest and the relative hours of labor w lowest during the last year for which the data are availa In the hosiery and knit-goods industries, the relative rate wages advanced from 105.6 in 1890 to 143.7 in 1912. relatively nominal full-time hours per week diminis during the same period from 101.1 in 1890 to 93.1 in 1 In other words, in this industry, also, the relative rate wages was the highest, and the relative hours of labor lowest, in 1912, for any year since 1890. These two indust may be considered fairly typical and conclusive evide that the two most concise illustrations of labor prog indicate a measurable advance in this direction of so welfare since 1840, an advance, in fact, so considerable t the present social condition of labor may properly be refer to as being in marked contrast for the better with the p vailing conditions of seventy-five years ago.

The corresponding progress made in other directions labor conditions can not be so concisely stated in statist terms. This observation applies particularly to the prohi tion of night-work for women and young persons, the grad attainment of a ten-hour maximum working-day for wom

he improvements in health conditions in industion in the rate of frequency of occupational he reduction in the rate of industrial accidents, serious. There are reasons for believing that employment in the principal industries is decidhe present time than in former years, and that economic condition of labor has distinctly imy because of the more effective organization of ring a much larger amount of continuous emn under the earlier conditions of excessive comisorganized business methods.

o complete statistics of American business as nted by wholesale and retail mercantile estaberhaps the most trustworthy index of business he annual record of commercial failures, which e year 1857, made memorable by a disastrous c. In that year the number of failures was e amount of liabilities $291,000,000. No such bilities became involved again until 1893, when ,242 failures, with $347,000,000 of liabilities. naximum figure reached in American commercial mber of failures during 1913 numbering 15,452, f liabilities being $203,000,000. In proportion umber of business concerns, the highest proe of failures since 1885 occurred in 1896, or The corresponding figure for 1913 was 0.98 nsidering the enormous increase in the nation's safe to assume that there has been a decided in business stability throughout the country, at he last twenty years.

of government revenue per capita has increased 1840 to $7.46 in 1913. During the last year of the per capita amount of government revenue

rdinary disbursements of the government have n $24,000,000 in 1840 to $683,000,000 in 1913. s on account of the Army increased from $7,000,- $1,030,000,000 in 1865, diminishing to $44,000,- but increasing to $161,000,000 by 1913. The

expenditures on account of the Navy increased from $6,000,(in 1840 to $122,000,000 in 1865, diminishing to $22,000,(by 1890, but increasing to $133,000,000 by 1913. Disbur ments on account of pensions increased from $2,600,000 1840 to $16,347,000 in 1865, and $175,000,000 in 1913.

The public debt, less cash in the treasury, increased fro per capita of $0.21 in 1840 to $76.98 in 1865, when the ag gate debt was $2,674,816,000. The per capita diminished $14.15 by 1890, and to $10.83 in 1913. The aggregate amo of the debt in the latter year was $1,050,000,000.

The total imports of merchandise in the United St increased from $98,000,000 in 1840 to $1,813,000,000 in 19 or 1750 per cent.

The exports during the same period increased from $1 000,000 in 1840 to $2,170,000,000 in 1912, or 1864 per cen

The amount of foreign trade carried in American vessels diminished rapidly between 1840 and 1912. The amount imports carried in American vessels in 1840 was 86.6 cent. of the total, against only 11.0 per cent. in 1912. amount of exports in American vessels during the same pe decreased from 80.0 per cent. to 8.1 per cent.

The amount of tonnage engaged in coastwise trade increa from 1,226,000 tons in 1840 to 3,832,000 in 1912, or 2 per cent. The tonnage on the Great Lakes increased du the same period from 54,000 to 2,950,000 tons. The tr through the Soo Canal increased from 106,000 tons in 1 to 8,454,000 tons in 1890, and 56,737,000 tons in 1912.

The railway mileage of the country in 1840 was only 2,8 By 1865 the mileage had increased to 35,085, and by 189 208,612. For the year 1912 the reported mileage was 356,3 Our aggregate railway mileage exceeds the combined rail systems of Austria-Hungary, Canada, France, the Gern Empire, Italy, Russia, the United Kingdom, Brazil, and Australia.

There were neither telegraphs nor telephones* in operat in 1840. By 1867 the number of telegrams sent was o 5,879,000; by 1912 this had increased to 109,378,000.

*See Bulletin No. 123 entitled "Telephones and Telegraphs, 1912," issued by the United Bureau of the Census, Washington, 1914; also the "Annual Report of the Directors of Am Telephone and Telegraph Company" for the year ending December 31, 1913, New York, 1914.

The telephone mileage in 1880 was 34,000, this by 1912 had increased to nearly 20,250,000. The number of persons employed in the telephone industry increased from 3,338 in 1880 to 183,000 in 1912.

The postal revenue of the United States increased from $4,543,000 in 1840 to $246,744,000 in 1912, or 533.1 per cent.

The number of patents issued during the quarter-century ending with 1864 was 49,071; during the quarter-century ending with 1889, 399,724; and during the period 1890–1912, 656,862.

The banking business of the nation has enormously developed, largely, no doubt, in consequence of the passage of the National Banking Act in 1863. The number of national banks increased from sixty-six in 1863 to 7,473 in 1913; and the amount of loans and discounts of national banks increased during the same period from $5,466,000 to $6,143,000,000. The amount of capital paid in was $1,056,000,000 in 1913. The amount on deposit in national banks increased from $119,000,000 in 1864 to $5,963,000,000 in 1913. Statistics of state banks are available for 1840, when the amount on deposit was $75,696,000. Subsequent to the National Banking Act the amounts declined, but a persistent growth has taken place since 1878, when the amount on deposit was $142,000,000, increasing to $553,000,000 by 1890, and to $2,920,000,000 in 1912. Statistics of loan and trust companies are not available previous to 1875, when the amount on deposit was $85,000,000, which by 1912 had increased to $3,674,000,000. The amount on deposit in private banks declined from $321,000,000 in 1875 to $152,000,000 in 1912; but during recent years this form of banking has also shown indications of substantial growth.

The number of savings bank depositors in 1840 was 78,701, which by 1912 had increased to 10,010,304. The amount on deposit in savings banks during the same period of time increased from $14,000,000 to $4,451,000,000, or 317 per cent. The average amount on deposit in savings banks increased from $178.54 in 1840 to $444.70 in 1912.

The total amount on deposit with all banks* increased from

*National, state, and savings banks and trust companies.

$2,182,000,000 in 1875, or $49.64 per capita, to $17,024,000,0 in 1912, or $178.43 per capita.

The amount of money in circulation increased from $10. per capita in 1840 to $20.58 in 1865, and $34.64 in 1913.

There are no statistics of local building and loan associatio for the nation as a whole previous to 1892. In that ye the number of shareholders was 1,359,000, which by 19 had increased to 2,517,000 or 85.2 per cent. The correspon ing growth in population during the same period of time w 49.0 per cent. The amount of assets increased from $47 000,000 in 1892 to $1,137,000,000 in 1913.

There are no trustworthy statistics of legal-reserve l insurance previous to 1860. In 1865 the number of polici in force was 209,392, which by 1890 had increased to 5,202,00 and by 1912 to 34,855,000, including the industrial busine which dates from 1875. The amount of legal-reserve l insurance in force increased from $580,000,000 in 1865 $19,264,000,000 in 1912. During the same period of time t accumulated assets increased from $64,000,000 to $4,409,00 000. The amount of legal-reserve life insurance per capi was $16.70 in 1865, and $201.90 in 1912.

For the United States as a whole there are no trustwort statistics of fraternal and assessment insurance previous 1885. In that year, according to the best obtainable retur there were 714,356 certificates in force, insuring $1,484,000,00 which by 1912 had been increased to 10,477,618 certificat and $9,924,000,000 of insurance in force.

Nor are there any trustworthy statistics of fire and mari insurance previous to 1890. In that year, according to *T Spectator*, a New York insurance journal, there were 5 companies operating in the United States, with a total inco of $157,000,000, which by 1911 had increased to 621 compani with an aggregate income of $410,760,000. The paymen to policyholders, including the business of Lloyd's and int insurance associations, increased from $80,000,000 in 18 to $203,000,000 in 1912.*

* According to *The Spectator*, the amount of marine and inland insurance in force in the Un States has increased during the last ten years from $888,730,000 in 1903 to $1,160,896,000 in 1 During the same period the losses incurred by the marine and inland insurance companies incre from $10,300,000 in 1903 to $16,622,000 in 1912.

0 there were thirty-four companies transacting
nd miscellaneous insurance, with a total income of
58,000, which by 1912 had increased to 189 com-
ith an income of $137,700,000. The annual pay-
policyholders during the corresponding period of
eased from $2,933,000 to $55,957,000.

cs of fire losses date back to 1875, when the reported
e National Board of Fire Underwriters was estimated
0,000. For the year 1890 the estimated loss was
000, and for the year 1911, $217,000,000. There
ailable statistics of maritime losses for a correspond-
d of time. The evidence, however, is quite conclu-
all forms of insurance have made rapid progress
he last thirty years, and largely out of proportion to
sponding growth in population, but in conformity to
expansion in commerce, of which insurance, in all
ches, is an essential element and necessary instru-
y.

ates of the wealth of the United States are largely a
f conjecture. For the present purpose the data pub-
the Statistical Abstract are accepted as approxi-
rustworthy, but there are reasons for believing that
unt of actual wealth is in excess of the estimate, which
ive of many sources more or less intangible, but none
mportant. There are no estimates previous to 1850,
e total amount was placed at $7,135,000,000, or $307.69
ta. By 1865, regardless of a vast amount of wealth
ion in the form of material property and slaves, the
as placed at $23,114,000,000, or $646.86 per capita,
y 1890 had increased to $65,037,000,000, or $1,035.57
ta. For the year 1914 the national wealth is con-
ely estimated $140,560,000,000, or $1,424.86 per

ducational progress of the nation is measured by the
on of illiterates, ages ten and over, in the total popu-
ges ten and over. There are no data previous to
n that year the illiterate population was 6,240,000,
er cent. of the total. By 1900 the actual number of
had diminished to 6,180,000, or 10.7 per cent. of the

total, and by 1910 to 5,516,000, or 7.7 per cent. Of the illi erates in 1910, 40.4 per cent. were negroes, and 25.0 per cen native whites of native parentage.

The total school enrolment has increased from 7,743,000 1872, or 19.0 per cent. of the total population, to 20,879,00 in 1911, or 22.3 per cent. There can be no question bu that the nation has made real educational progress, not on as measured by the rather crude educational statistics, bu much more so by the larger proportion of population of scho age in the higher institutions of learning.

There are no recent statistics of marriages for the nation a whole, but the returns for Massachusetts may possibly i dicate present-day tendencies in the more densely populate section of the country with approximate accuracy. Durin the period 1850-54 the marriage rate of Massachusetts wa 16.8 per one thousand of population, ages fifteen and ove decreasing to 13.6 during the five years ending with 1864, 12.7 during the five years ending with 1890, and to 12.5 durin the five years ending with 1911.

In this connection, a brief reference may be made to th statistics of divorce, as having an important bearing upon ou moral progress, but no data are available previous to 186 It is a statistical fallacy to determine the ratio of divorces the marriages contracted during the current year in which th divorces were granted. The statement frequently made th in this country 1 marriage in every 12 terminates in a divorc is a serious and inexcusable statistical error. In 1910, for illu tration, there were 18,098,000 married males in the Unite States and only 156,000 divorced males. The ratio of divorce men to married men was, therefore, 1 to 116. The number married women was 17,688,000, and the number of divorce women 185,000. The ratio of divorced women to the marrie was, therefore, 1 to 96. The annual divorce rate per on hundred thousand married population has increased, howeve from 81 in 1870 to 107 in 1880, 148 in 1890, and 200 in 190 The condition is alarming, but not as serious as frequently a sumed. Divorces attract vastly more attention than ma riages, and they are naturally drawn from the existing bod of the married and not by any means exclusively from th

marriages contracted during the year in which the divorces were granted. Of the total married, widowed, or divorced male population in 1910 only 0.79 per cent. were divorced. For the female population the corresponding figure was 0.88 per cent.

There are also no trustworthy statistics of births for the nation as a whole, but using again the statistics of Massachusetts, it appears that the birth rate has declined from 100.4 per one thousand of females, ages fifteen to forty-nine, during the five years ending with 1854 to 90.8 during the five years ending with 1911. It may be questioned, however, whether the actual decline in the birth rate has not been more pronounced than is indicated by the foregoing rates of a state in which the conditions have been seriously disturbed by a large influx of distinctly fertile races, such as French Canadians, Italians, and Portuguese. Without enlarging upon the statistical aspects of the problem, it may be safely assumed, on the basis of reasonably trustworthy data, that there has unquestionably been a material decline in American fecundity and the size of the family and a corresponding increase in the proportion of native married women without children. This view is sustained by the maternity statistics of Rhode Island and by the special analysis of the United States census of 1900 for selected localities.*

The health progress of the nation since 1840 is concisely shown by the vital statistics of our large cities. Combining the available data for the seven cities of New York, Philadelphia, Chicago, Boston, Lowell, Baltimore, Charleston, and New Orleans, it appears that the death rate for the five-year period ending with 1844 was 24.2 per one thousand, against 27.6 for the five years ending with 1864, 23.2 for the five years ending with 1894, and 16.4 for the five years ending with 1912. The most notable documents on the health history of the nation at early periods are the first report of the Committe on Public Hygiene of the American Medical Association, published in 1849; the Report of a General Plan for the Promo-

* See "Maternity Statistics of the State of Rhode Island," by the present author, Proceedings First International Congress of Eugenics, London, England, also "The Comparative Fecundity of Women of Native and Foreign Parentage in the United States," by Joseph A. Hill, Quarterly Publications of the American Statistical Association, No. 104, December, 1913, Boston, Mass.

tion of Public and Personal Health, made by the Sanitary Com-
missioners appointed by the Massachusetts Legislature a
published in 1850; and the report of the Executive Committ
to the Council on Hygiene upon the Progress and Prese
Condition of Sanitary Inquiry, published by the Citizen
Association of New York in 1865. Mention may also be ma
of the report on the Causes and Prevention of Yellow Fev
at New Orleans and other cities in America, published in 185
and the report of the United States Government on the Chole
Epidemic of 1873. The first state to inaugurate the registr
tion of vital statistics was Massachusetts, commencing
1857.

The most notable decline in American mortality has be
in the death rate from tuberculosis. A material reductio
however, also has taken place in the mortality of infants, a
in the mortality from all of the acute infectious diseases, i
cluding smallpox which as a cause of death has practically be
eliminated. There has been no cholera epidemic since 187
and practically no yellow fever since 1905. The fall in th
death rate, however, has chiefly affected ages under fort
and some of the degenerative diseases of adult life, includin
cancer, have increased.

Statistics of inmates of institutions are available only wit
approximate accuracy since 1890. At the time of the Eleven
Census the rate of inmates of all institutions for the defecti
and dependent classes was 590 per one hundred thousand
population, against 808 in 1900, and 915 in 1910. This i
cludes criminals and juvenile delinquents. The most alarm
ing increase, apparently, has been in the number of inmates
benevolent institutions, the range having been from a ratio
180 in every one hundred thousand of population in 1890 t
355 in 1900, and 433 in 1910. The ratio of the insane decrease
during the same period from 188 in every one hundred thousan
of population in 1890 to 186 in 1900, but the ratio increased t
204 in 1910. The ratio of the feeble-minded increased from
8.4 in 1890 to 18.6 in 1900, and 22.5 in 1910. The ratio of th
blind and deaf increased from 12.2 in every one hundred thou
sand of population in 1890 to 18.0 in 1900, but diminished t
16.8 in 1910. These figures are not indicative of progres

ey should be accepted with caution. It has to be
ccount that there is a gradual accumulation of in-
count of a higher recovery rate and a diminished
n institutions—for illustration, of the insane and
ed, and to a certain extent the same conclusion
risoners and paupers. The ratio of paupers in
diminished from 117 in every one hundred thou-
ulation in 1890 to 101 in 1900, and 92 in 1910.
corresponding diminution in pauper burials, for
ata are available for several large cities. In these
verage annual pauper burial rate per ten thou-
al population was 28.0 in 1875 and only 9.1 in

ial statistics are, unfortunately, rather unsatis-
inconclusive. The statistics of prisoners, as ascer-
he Census, are fairly trustworthy since 1850. In
e ratio of prisoners to every one hundred thousand
n was 29.0, which by 1860 had increased to 60.7,
5.3, by 1880 to 116.9, and by 1890 to 131.5. The
s are for the year 1910, when the rate was 121.4,
stion may be raised as to whether there has not
tual increase, when full allowance is made for
nissions of certain classes of prisoners considered
ous enumerations. Our statistics of crime, as far
be relied upon, indicate that matters have not
ut rather, to the contrary, that there is a tendency
increase in lawlessness, as best indicated perhaps
tics of homicides of American cities. Combining
s of deaths from homicide for the two cities of
New York, it appears that the rate for 1839–43
million of population, and 53 for 1908–12. For
ican cities during the last thirty years the homicide
n 49 per million for the first decade, 49 per million
ond, and 75 per million for the third. There has
corresponding increase in the suicide rate, but the
ot call for detailed discussion.*

rage annual suicide rate in one hundred American cities was 15.2 per one hundred
ion, and by 1912 this rate had increased to 18.8. See my Review of the Suicide
The Spectator, New York, October 2, 1913.

A statistical history of the conditions of labor would mal
an exceedingly instructive addition to knowledge. Much
the information contained in the documentary history of Ame
ican industrial society proves the occurrence of at least occ
sional periods of widespread poverty, unemployment, and di
content. The historical development of our American po
law, commencing with the early colonial period, affords abu
dant evidence of the existence of much poverty even during
period when the land was practically unsettled, when the co
of the necessaries of life was exceedingly low, and when oppo
tunities for work must have been relatively abundant. T
documentary history of American poor relief is exceeding
suggestive of a disorganized state of society, of a public poli
of indifference, and an absence of thoroughly well conceiv
measures of public relief. Reference may be made to an a
for the relief of the poor of the city of Philadelphia, publish
in 1818; a somewhat similar act for the relief and employme
of the poor of the city of Philadelphia, published in 1828;
report of a committee appointed at a town meeting of the ci
zens of the city and county of Philadelphia to consider t
subject of the pauper system, in 1827; the report of a simil
committee of the Board of Guardians of the poor of the ci
and districts of Philadelphia, with instructions to visit t
cities of Baltimore, New York, Providence, and Salem, pu
lished in 1827; a report on poorhouses and jails in New Yo
City, in 1834; and the interesting observations of Theodo
Sedgwick in his treatise on public and private economy, pu
lished in New York, 1836. I may also refer to the Census
Boston, published in 1845, and the Census of Charleston, pu
lished in 1848.* These are but mere indications of a conside
able degree of social unrest and economic dependence preva
ing at a time when the American Statistical Association ca
into existence, in 1839; yet even at this early date H. C. Care
in his Principles of Political Economy, published in 1839, a
signed to the United States, in comparison with England, t
Netherlands, and France, the first rank in political securit

*An account of some very interesting observations on pauperism and crime. See in this con
tion my address on "Statistics of Poverty and Pauperism," published in the Proceedings of
National Conference of Charities and Correction for 1907.

n of life, the growth of population, the rate of he rate of fecundity, the condition of morality, bsorb immigration, and, finally, the efficiency of ing due weight to all the facts which require con- n so hazardous a conjecture, it would seem still tradiction that after seventy-five years the United tains its preëminence over all other nations of the hese eight fundamentals of social and economic

foregoing evidences of our material progress are d indisputable, save that in a few directions there viously no advance, but, on the contrary, a retro- The evidence is incontrovertible that on the whole een measurable progress in the United States in rtant direction affecting the material well-being of n the sense of Professor Ashley's definition, that to g degree they are provided with more abundant food rence, with better conditions of housing, so as to ., if they choose, to lead more healthy and pleasant as been shown that the production in agriculture ctures has considerably increased, and more than tely to population, with higher wages, shorter oor, and comparative freedom from demoralizing s of employment. The substantial decline in the from practically all of the recognized preventable iefly typhoid and tuberculosis, gives evidence of a provement in the average duration of life, which be followed by far-reaching economic results. hours of labor and the lessened employment of industry provide not only more sufficient leisure unity for affection, but also the required amount reation, and vacations, as a prerequisite for the e of individual health and physical efficiency. ics of education give evidence of the intellectual the nation, which, on the whole, challenges favor- rison with other civilized countries, more advanta- uated on account of the absence of a large negro -born population. The statistics of savings banks, d loan associations, and life insurance companies

and societies give evidence of a wide diffusion of thrift and increasing equalization in the distribution of wealth, grea per capita undoubtedly in the United States than in any otl country of the world. This conception of wealth per cap includes the many forms of intangible wealth, with regard which there is not sufficient statistical evidence, but as to t existence of which in vast amounts there can be no reasona question of doubt. This particularly is true of the colos amounts of mercantile credits, which constitute a large porti of the working capital in small industries and mercant establishments. It has also been shown by the diminuti in mortgage indebtedness of farms and the rising equities agricultural holdings, that in this country during the l twenty years there has been a measurable and mater advance. Additional thereto, it has been shown that t average value of farms has increased out of all proportion population during the last generation, and it may safely maintained that there is nowhere today a more prosper agricultural population than in the United States. Our pr ent growth of population warrants the forecast that fi years hence we shall number approximately 200,000,000, b even then we shall only have attained a relative density equ to about one fifth of that of the German Empire at the prese time.

All this constitutes verifiable and indisputable progress, possibilities of the nation's future advance in the direction social and material well-being. The indications of an abse of progress are those of a diminishing merchant marine, th which there is perhaps no more inexplicable phase of our n tional development, considering the marvelous achievements American navigation during the period when the nation w in its infancy. That there has been an enormous waste natural resources is indisputable, but such waste was pra tically inevitable in a new country of such vast extent as t United States and one making such rapid growth in popu tion. There are, however, also far-reaching compensatio for our past failures to husband our natural resources to be advantage, and there has come about a realizing sense of r sponsibility, reflected in the increasing amount of attenti

to the economies of production and the more general utilization of what were heretofore considered the waste products of our industries. Even more regrettable than the evidences of our ruthless exploitation of invaluable natural resources are the obvious evidences of a declining birth rate, a diminishing size of the American family, a rising divorce rate, and an apparent increase in the frequency of lawlessness and crime. These, however, are probably but passing phases of our national existence and the incidental results of a process of readjustment, following our rapid economic advance, on the one hand, and the gradual and only partial absorption of an enormous influx of alien elements from abroad, on the other.

Nowhere in the entire world is there an equal amount of widely diffused material prosperity combined with an equal amount of personal freedom, adequate compensation for services rendered, and leisure time for the enjoyment of the pleasures of life. No equal area in the world affords such a range of opportunity for material advancement of every kind and degree as the United States, from the Arctic shores of Alaska to the semi-tropical island of Porto Rico in the West Indies and the tropical possessions of the nation in the Far East. No one in 1839, when the American Statistical Association came into existence, even though gifted with the most marvelous imagination, could have made a true forecast of the nation's achievements by the year 1914, and it would be equally futile to indulge on this occasion in prophecy, further than that compared with what has been, the future of these United States will unquestionably and by far outdistance all the material, intellectual, and moral achievements of the past. The nation will become more and more a dominating factor in the control of the world's affairs, and its influence will be most profoundly felt in the maintenance of the world's peace. It is largely because of the absence of international strife that the United States is able to look back upon a prolonged and uninterrupted record of advance—advancement with which there is nothing to correspond in the past history of mankind. It is but fitting that in a democracy the gains resulting from such progress should have accrued to the material benefit of

the vast majority of the people, and nowhere, it may be as-
serted without fear of contradiction, are the toiling masses so
conspicuous and effective in their power and control of national
affairs as in the United States. The present is a transitional
period, fraught with many serious moral, as well as economic
problems; but with the assurance of economic well-being and
economic security, there will gradually come about a realizing
sense of greater personal responsibility and answerableness in
the possession of a new freedom which, even more than any
concrete material evidence, will visualize the true and enduring
advancement of the American people.

RECORDS OF HEALTH AND SANITARY PROGRESS.

By Robert E. Chaddock, Ph.D., *Associate Professor of Statistics, Columbia University.*

Health and safety have not been the fundamental considerations in locating and building our cities. Population has concentrated in certain centers because they were favorable for productive enterprises or mercantile operations. These communities may be swept by flood or earthquake and they are rebuilt in an incredibly short time. Bad housing and sanitation have cost thousands of lives each year, but the tide of population is not turned back from the city. Bad working conditions are responsible for scores of thousands of crippled and inefficient workers and yet the laborers continue to submit themselves to the dangerous conditions. The desire for economic advantage has made some forgetful and others reckless of human welfare and individual happiness. The pressure of economic necessity has prevented many from asserting their rights to better living and working conditions. Ignorance of the facts has kept silent many who would otherwise have protested.

The city should know more about itself. If it is to become more than a labor market and place of business; if it is to be made a healthy and comfortable place in which to live as well as to work, more exact data should be recorded concerning the bad effects of certain city conditions upon the health and welfare of the urban population. A great advance in this sort of knowledge already has been made. Such information is leading to a policy of city planning instead of allowing cities to grow up haphazard. Every addition to our knowledge reveals the lack of proper adjustment, the existence of selfish exploitation and the absence of coöperation for the common welfare.

A scientific laboratory is a place where observations are made and recorded; where the conditions of an experiment are carefully arranged and the results noted; where the relations of cause and effect are investigated. There is a sense

in which the city may serve as a health laboratory. Ob vation and analysis of the phenomena as we find them reveal relations of cause and effect which are of the grea significance in community action for the common welf The term "survey," recently applied to the effort of a c munity to find out the facts about itself, emphasizes the s viewpoint.

One of the most active health campaigns is directed aga the high infant death rate. Miss Julia C. Lathrop, chie the Children's Bureau, finds that 42 per cent. of the ba dying within the first year of life die within the first mon Of this number about seven tenths die, according to same authority, as a result of conditions existing before t were born or as a result of injury or accident at birth. H much of this high mortality may rightly be attributed to work of the mother and her working environment, or to l hours of work up to the time of childbirth? How many hea departments attempt to relate infant deaths to the work the mother? A special investigation recently made by age of the Bureau of Labor presents data on this problem for F River and certain other Massachusetts towns,† but ther need of a constant and widespread analysis of the inf deaths in every city according to the occupation of the mot and her hours of work. How else can it be determined w legislation is needed providing for a period of cessation fr work before and after childbirth and for the regulation employments dangerous to the health of the mothers of generation yet unborn?

Dr. Watson S. Rankin, Secretary of the North Carol Board of Health, tells of a town in his state which had quired a railroad to build an overhead bridge at a cost of $18, because, during a period of ten years, ten fatal accide had occurred at that crossing. The interest on the origi cost of the bridge plus the annual wear and tear would amo to at least $1,500 per year. This sum the company was co pelled to pay each year to save one needless death. T authorities of this town of 4,000 population were spend

* Prenatal Care, Publication No. 4, United States Children's Bureau, Washington, D. C. 1913, p.

† Report on Condition of Women and Child Wage-Earners in the United States, Sen. Doc. 645, 13, 61st Cong., 2nd Sess., 1912.

$150 annually in their health administration. A visit to their registrar of vital statistics showed how many needless deaths from various causes had been occurring each year. The general death rate was 27.5 per 1,000 population, which was 12.5 persons in each thousand higher than the rate for the average community. Therefore, about fifty lives were being needlessly sacrificed each year. Their death rate from tuberculosis was twice the average and from typhoid more than seven times the average. This was a sick town, but it was unconscious of the real health situation, and, therefore, inconsistent in measures for health preservation.*

The discovery of the typhoid bacillus and the knowledge of its mode of entrance into and its exit from the body has led to the recognition that typhoid fever is a preventable disease. In theory, it is possible to eradicate this disease completely by protecting food and water from all contamination and by the destruction of all typhoid germs excreted from the body. The degree of success with which this knowledge has been applied varies greatly in European and American cities. The typhoid death rate per 100,000 of population in Paris, in 1910, was 6.7; in Vienna 4.1; in London 4.0; in Berlin 3.6, and in Hamburg 2.5. These and other European figures show an average mortality from typhoid of about 4 per 100,000. The showing of the cities of 100,000 and over in the United States in comparison is not flattering. Of the fifty such cities in 1910 only four showed a typhoid rate of 9.5 per 100,000 or less, while nine of these cities exceeded 40 deaths per 100,000 of population. The average rate for the fifty cities was 25 deaths per 100,000, about six times the European rate.† Evidently, there are many difficulties in the campaign of prevention to be carefully analyzed and wisely solved in this country.

The Utility of Vital Records.

If we would secure better statistics of births, deaths, and sickness, it is necessary to show for what purposes they may be used.

*The Influence of Vital Statistics on Longevity, W. S. Rankin, The American Underwriter, January, 1913, pp. 2–3.

† Monthly Bulletin of the State Board of Health of Massachusetts, February, 1913, pp. 57–59.

(1) *Vital statistics are the bookkeeping of the health m*
ment. Population is added to by births and subtracted fr
by deaths. Sickness and disability data measure the p
sible efficiency of the existing population. Whatever aff
either births or deaths, conditions the very existence of
population. That which causes sickness and disability
ditions efficiency and happiness. By reducing the death
the healthy increase of the population may be maintained
a lower birth rate and without the burdens connected
the rearing of children and with sickness and death.

Too often the profit and loss account of a business firm
kept no record of the human wear and tear or of the hu
gains of certain business policies. Vital records should su
this neglected information. Laws may make it to the fi
cial interest of the employer to count these human wa
and to prevent them. At present we must depend upon
mates of how many fatal accidents and non-fatal injuries o
in industry each year, or how many workers in lead or o
dangerous substances are poisoned. Why should a prob
annual toll of 30,000 fatal accidents in industry in the Un
States or of 2,000,000 non-fatal injuries be left to estim
A careful analysis of facts, conscientiously recorded, w
show the effect of the adoption of safety devices or the lo
which result from neglect of safety precautions. When
New Haven Railroad has an accident causing the loss
score of lives, it is made a matter of several public inqui
with the effort to show the causes and whether the los
lives might have been prevented. What of the army of labo
who are destroyed or maimed each year in industry?
need to know where and how and why in all these case
order that the community may be informed of its waste
human life and efficiency. Even employers themselves
to be shown by a careful record that the removal of dust
poisons from the factory or the protection of the worker f
their effects brings about less lost time through the sick
of employees, and enables the worker to turn out more
better products.

Likewise with preventable disease and sickness. We
depend upon the estimate of 150,000 deaths annually f

tuberculosis in the United States and of 500,000 persons continually ill from the same disease.* Analysis of the facts of this disease which causes one tenth of all deaths, and that largely during the productive period from 25 to 45 years of age, must result in fixing responsibility upon housing and working conditions, and upon ignorance. Since the disease is recognized as preventable the records ought to show what methods have yielded the best results in reducing mortality and sickness. The measure of success or failure of preventive work is found in vital statistics.

It is estimated that 300,000 babies in the United States died last year before they were one year old.† The records of this appalling waste of infant life, carefully analyzed, ought to show the causes and make clear the lines of preventive activity. No business firm would dare to be as careless of raw material and mechanical equipment as our communities have been of life and health. No one can estimate the poverty and misery which result from such neglect. There is the greatest need for careful community records of the human losses and gains in the struggle for progress.

Birth statistics are less accurately collected in most of our states than deaths, but the immediate public record of a child's birth is of absolute importance to the health authorities. In case the family cannot afford adequate medical and nursing care aid may be furnished at once to mother and child. New York City employs the school nurses during the summer in the campaign against infant mortality in addition to the regular staff of infant nurses. A number of infants are assigned to each nurse, whose duty it is to visit the homes and instruct the mothers on the care of the babies and to secure medical and other care where needed. Obviously, this method of work, whether by municipal or volunteer agencies, is greatly facilitated by early and complete registration of births.

(2) *Vital statistics show us where to look for bad health conditions and demonstrate the success or failure of a new health policy when adopted.* To the health official and investigator

*Report on National Vitality, Irving Fisher, Bulletin 30 of the Committee of One Hundred on National Health. 1909.

† Prenatal Care, op. cit., p. 5.

they serve the same purpose as symptoms to the physici
To the sanitarian they are what chart and compass are to
navigator. Arthur Newsholme, the English statistician,
clares that modern sanitary science owes its existence to
registration of deaths and their causes. Frederick L. Hoffm
maintains that vital statistics alone furnish a definite meas
of the value of sanitary improvement and the progress of me
cine and surgery.

In 1907 the typhoid death rate of Pittsburgh was 13
per 100,000 of population, which showed criminal neglect
the community in the face of sanitary knowledge. The
lowing year showed a rate of only 46.6—after a filter pl
had been installed. The further extension of the use of filte
water and the better enforcement of other sanitary provisi
reduced the rate to 25.9 in 1911.* Thus, within a period
four years, the rate had been reduced four fifths, and in
single year of 1911 over 500 lives were saved which would h
been needlessly sacrificed to this one disease if the old rate
1907 had prevailed. This sort of record-keeping convin
the community that a specific health policy is worth wh
It demonstrates to the health department itself, by compa
son with the results of other policies, the most effective meth
of saving lives and preserving health.

The last four summers have been noteworthy in the hea
movement in New York and other cities because of the s
cess of certain plans for the reduction of infant deaths. M
depots were opened, either under the direction of priv
associations or the health authorities, nurses and doctors w
detailed to give instruction to the mothers and to care for
babies both at the stations and in the homes. The care
weekly record of the vital facts during the dangerous mon
of mid-summer tell a story of success and measure the ext
of it by comparison with preceding efforts. The wisdom
this form of effort and expenditure has been demonstrat
The belief that ignorance is fundamental in the infant m
tality problem has been demonstrated beyond a doubt.

It has been shown that the method of feeding is an importa
element in the infant problem, yet, no health department,

* Annual Report of the Dept. of Public Health, Pittsburgh, Pa., 1911-1912, p. 56.

far as the writer is informed, attempts regularly to correlate infant deaths with the method of feeding. The facts of this relationship are essential in an educational campaign among the mothers in the effort to reduce mortality. Dr. William H. Davis, Vital Statistician of the Boston Health Department, has conducted a special investigation in Boston, the results of which were presented at the International Congress on Hygiene at Washington in September, 1912.* One of the chief objects of milk-station and home instruction of mothers before childbirth is to cause more mothers to nurse their babies and better prepare them for doing so. If we are to measure the effectiveness of this method, we should collect the information as to the method of feeding in the case of each infant death, as a test of the educational and prenatal work. The dangers of the artificial food supply of the infant are connected with the ignorance of sanitation and with the bad living conditions amid which so many of the poorer classes rear their children.

(3) *Vital statistics may be related to other social phenomena such as occupation, housing, and nationality.* To analyze this relationship often points the way for an effective preventive campaign. What answer can most health departments give to the question of the relative morbidity and mortality from specific causes in different occupations? Yet, the occupation is recorded on the death certificate and many of our communities are carefully registering and supervising cases of tuberculosis. We find the insurance company making a detailed analysis of deaths by occupation because it is in the interest of its business to measure the variety of risks involved in different occupations. Such an analysis by the Prudential Insurance Company is shown in the following table:

* Transactions of the Fifteenth International Congress on Hygiene and Demography, Washington, D.C., 1912, Vol. 6, pp. 184–190.

PROPORTIONATE MORTALITY BY CAUSES AND OCCUPATIONS, AGE 15 AND OVE
PRUDENTIAL INSURANCE COMPANY, 1907-1910.a

Cause of death.	All Occupied Males.	Farmers.	Clerks.	Coal Miners.	Iron and Steel Workers.	Carpenters.	Painters.	Plumbers.	Prin-ers
Typhoid	1.8	1.2	3.0	3.0	2.2	1.0	1.2	2.5	2.
Alcoholism	1.5	.3	.5	.6	1.0	1.1	1.4	1.9	1.
Cancer	4.3	6.1	2.1	3.7	4.6	5.7	3.4	2.4	2.
Tuberculosis	21.9	10.2	36.7	11.1	19.4	16.1	28.8	22.9	26.
Old age	.9	2.9	.2	.2	.8	1.4	.6	.1	.
Apoplexy and paralysis	7.8	14.6	4.6	6.1	7.1	10.9	8.4	4.7	4.
Other nervous diseases	2.7	3.5	3.5	1.6	2.9	3.7	2.3	3.2	3
Heart diseases	9.2	12.7	7.9	6.8	8.8	11.4	6.1	5.2	10
Pneumonia	6.9	8.2	8.1	11.4	9.7	7.8	7.4	7.7	5
Other respiratory diseases	3.4	3.6	2.2	9.3	2.8	3.3	2.5	1.7	2.
Liver diseases	2.9	2.1	2.2	2.5	2.3	2.5	2.7	2.6	2.
Other digestive diseases	4.1	4.9	4.3	3.9	4.6	4.3	3.7	4.5	3
Urinary diseases	12.0	12.9	9.6	8.0	9.9	13.4	16.1	11.1	8
Accidents	9.3	5.8	6.7	22.9	15.3	7.8	8.6	11.7	5.
Suicide	2.2	1.6	1.9	.9	1.8	2.7	2.9	1.9	1.
Lead poisoning	.1	....	....	....	....	....	1.5	....	...
All other causes	7.1	10.2	6.6	10.1	6.8	8.0	6.5	5.0	3
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100

a Exhibits of the Prudential Insurance Company at Fifteenth International Congress on Hygiene Demography, Washington, D. C., 1912 (Compiled). Percentages copied as in the original but they not always add to 100.0%.

A glance at the above table* reveals a widely different mo tality for different occupations from such causes as tuberc losis, urinary diseases, and accidents. This is prelimina information to the discovery of why mortality is high fro specific causes in certain occupations. We need consta analysis of all mortality returns and cases of reported illne by occupation. Regulation of conditions which destroy heal and sacrifice lives will surely follow. Special inquiries, su as that recently made in Illinois by Dr. Alice Hamilton in New York State by the Factory Investigating Commissio to discover the nature and extent of lead poisoning in industr are not adequate.†

The report of the New York Congestion Committee‡ a special studies on housing made in Chicago§ and Bosto emphasize the close relationship between housing and healt

*To bring out the real significance of these figures the deaths must be analysed by divisional period life. This the Insurance Company has done in each occupation.

† Preliminary Report of the Factory Investigating Commission of New York State, 1912, Vol. I, App dix VI.

‡ Report of the New York City Commission on Congestion of Population, 1911.

§ American Journal of Sociology, September, 1910, to September, 1911.

‖ Report of the Homestead Commission of Massachusetts, Boston, 1913.

ed that crowding has a vital relation to the prob-
rculosis and infant deaths. But how many cities
act and continuous data as to the extent of room-
d its relation to the death rate? The numbers
re in various sections are not comparable because
is taken of the part of the area devoted to other
n residence or of the varying heights of dwellings.
ve have not the data to measure the influence of
upon health with even an approach to accuracy.
measuring the bad effects of the city environment
ople who dwell there will the movement for city
ure its effective motive power and justify, in the
unaffected by artistic motives, the large expendi-
to make the city a healthy place in which to live.
and morbidity rates vary among different nation-
instance, the infant mortality and tuberculosis
ch lower among the crowded Hebrew population
East Side in New York than on the much less
est Side where different nationalities dwell.* A
tion of our immigrant population is coming into
ronment which is utterly different from that to
have been accustomed. Ignorance is the most
ace to their health. Urban conditions become
angerous in this situation. For this reason it is
ant that sickness and mortality data be analyzed
ty and specific causes. Year by year the cases of
ness and the deaths from tuberculosis among the
and those of foreign descent should be correlated
mber of years spent in this country, in order to
w the new environment registers its effects upon
of the immigrant. Knowledge of the facts would
surely to wise provisions to control the disease
s gained too strong a foothold, including an edu-
licy to aid adjustment in the new surroundings.
cities the death rate of the colored race from tuber-
o or three times the rate for whites. Adjustment
life is not successful and the race would die out if
ed constantly from the South. Employment is

nfant Life. Edward T. Devine, Survey, December 4, 1909.

intermittent, housing conditions are bad, incomes are low, an rents are high. There is complete ignorance of sanitary pr cautions. Therefore, the race has fallen a victim to tuberc losis. It is a menace to the health of the community to ne lect the health of any part of its population. The effects city conditions should be measured and then such policies ma be adopted as will counteract the bad effects and promo the good influences.

(4) *Vital statistics have a most important practical beari upon the problems of widows' pensions and minimum wag* It may be expedient to grant pensions to widows but it not a complete solution. If granting such pensions shou lead the community to believe that by so doing it had fu filled its entire responsibility the plan would be an unmitigate evil. A fundamental inquiry is not as to how much the wido needs from the state, but how she comes to be in need at a At the critical period when a family was being reared did son fatal accident or preventable disease deprive the family of i natural support? If so, the logical solution is to preve these dangers to life and health, so far as possible, and meet by a system of social insurance the burdens which ca not be avoided. Upon such observation and knowledge preventive work based, and a solution worked out in th manner becomes permanent.

The minimum wage idea is in danger of being regarded a panacea for the ills of low wages. It may be expedient have a minimum wage for certain work but the law will n endow those of low earning capacity with higher earning powe Too many are not earning more than they receive. A fund mental inquiry must not be forgotten—why are wages lo The minimum wage legislation may prove a good method bringing into view the group with low earning power. It w then be possible to observe and measure more accurately th results of accident and disease and fatigue in decreasing ear ing ability, the effects of working too early in life or under ba working conditions in shortening the working life, as well many other causes of low wages. The community will the be in a position to remedy these various causes whose com bined effects are low wages.

(5) *Vital statistics make possible the wise and efficient administration of a health department.* "Public health is purchasable" reads the motto of the *Monthly Bulletin* of the Department of Health of the City of New York. Following this idea the city spends several million dollars each year in its health administration. This is a big business undertaking. The object of every health department should be to secure as large a return in lives and health as possible for a given expenditure.

The head of a business firm asks of his bookkeeper more than a statement of general results. He wishes to know what lines of effort have yielded the best returns and what, if any, have been conducted at a loss. He wishes to know the weak spots in his system of business administration in order that efforts may be concentrated at those points. Likewise, the health department of a city should ask of its bookkeeping division—the bureau of vital statistics—what causes of death are increasing and what are decreasing both in the community as a whole and in particular smaller localities? What occupations are so dangerous to health as to require regulations for the protection of the employees? In what sections of the city, among what nationality, or under what sort of industrial and living conditions is the mortality of infants high? Does the crowding in a certain area, as measured by the number of persons per room, result in a higher death rate? What is the relation of the milk supply to health? What effect has the milk station upon health? What trades are especially dangerous from the point of view of tuberculosis? Is one nationality more susceptible than another? Are the housing conditions in certain areas especially responsible for the high rate in those districts? How much lower is the rate where hospitals and sanatoria have been provided for dangerous cases, and where nursing and instruction are given in the homes? Most of these questions are not adequately answered by data collected and analyzed by the city bureaus of vital statistics. Without such information the health department is not in a position to expend its money and energy to the best advantage in preserving health.

These facts are also needed to educate the public in t health needs of the community in order that they will indo more adequate appropriation of funds for the health depa ment. The educational function of vital statistics, prope presented, is most important in the preventive work, wh not only must the individual be made to understand the co mon dangers to which he is exposed, but also that he ha right, in coöperation with others, to demand protection throu community agencies, such as the health department and bui ing department of the city. The public must be brought realize, by seeing the actual figures or a graphic device ba on actual figures, to what extent a bad water supply increa the cases of typhoid; how much impure milk raises the inf sickness and death rates; that bad sanitation results epidemics of diseases; that bad housing increases the cases tuberculosis; and that too few food inspectors endanger health of thousands in the community. Then the pu will support additional expenditures to improve these c ditions. Health departments have just begun to popular a part of their collected data and to publish it in the form weekly or monthly bulletins or through the newspapers. T Chicago Health Department is a leader in this form of act ity. Within the last year the New York City Health partment has organized a Bureau of Public Health Edu tion. Just as the physicians are more and more taking community into their confidence by popularizing and p lishing information on the nature and prevention of dise so must health departments widely extend the movement popular education to enlist coöperation in the preventive wo

The chief hindrance to effective effort in the health depa ments of most cities is the lack of adequate funds. We h some very significant facts, in the prosperous states of Illi and New York, as to the compensation paid to the ch health officer in various cities. Dr. Palmer, of Springfi Ill., reports the results of his inquiry in that state in a pa entitled, "The Shortcomings of Municipal Public Hea Administration," published in the *American City* for Aug 1911. He ascertained the facts in forty-four Illinois cities 3,000 population or over. Thirty-six of these cities pay

than unskilled workman's wages to their chief health officers. Twenty-one of the forty-four cities have no appropriation for public health purposes, or only that for the payment of the nominal salaries of officials. Two cities of over 20,000 population each propose to give health protection at a cost of $300 per year. Twenty-nine of the forty-four cities employ no inspectors at all. While fifteen of these cities exceed 20,000 in population and three are over 50,000, not one city pays sufficient salary to its chief health officer to warrant a competent man in devoting all his time to the work. One city of 59,000 pays $1,500 per year, the highest salary paid to any municipal health officer outside Chicago; a city of 70,000 pays $1,200, and one of 51,000 pays $1,000. The twelve cities paying nothing include one of 30,000, one of 22,000, and one of 21,500 population. How could the health and lives of the people be adequately protected in such a situation?

The Special Health Commission, appointed by Governor Sulzer, and reporting to the New York Legislature last year, revealed about the same situation for the cities of New York State.* The Children's Bureau at Washington, in making inquiry as to activities in various cities of the United States, in the campaign against infant mortality, received this reply from the board of health of a city of 687,029 population, dated February 20, 1913: "I have to advise that the health department has no funds available for organizing a division for the care of infants." Another health officer in a city of over 168,000 said: "We have been unable to get an appropriation from the city council for carrying on a campaign of this kind."† Therefore, it is desirable to accumulate such an array of vital facts, so clearly analyzed and presented, that the truth of the New York Health Department motto will become generally recognized—*that health is purchasable.* Then the appropriations will become more adequate. The public does not look at all or looks in vain among the pages of the average health report for information which will furnish convincing proof or disproof of the efficiency of past policies and which will guide to an intelligent shaping of future policies.

* Governor Sulzer's Message on Public Health with the Report of Special Public Health Commission, Albany, 1913.

† Baby-Saving Campaigns, Publication No. 3, Children's Bureau, Washington, D. C., 1913, p. 11.

Importance of the Unit of Area in the Tabulation o Vital Statistics.

In most cities, at the present time, deaths and other vit facts are tabulated by political divisions, not by sanitary area Moreover, the unit of area is too large. It includes man different kinds of sanitary and housing conditions. For pra tical or scientific use by the sanitary and health officials is not sufficient to calculate the death rate for an entire ci or even a ward. In one part of the ward or assembly distri or borough, health conditions may be very good, in anoth part the conditions may be very bad. To calculate a rate f the entire area shows nothing that is true, for it does not repr sent either the good or the bad part of the area. And y most of our cities publish the tabulations for the entire ci or for each borough, or at best by wards.

The general death rate year by year is useful in showing t sum total of success or failure in the efforts to preserve healt The general death rates of two cities may be compared a methods successful in one may be adopted in the other wi like favorable results in reducing the rate. But, for acti operations in a specific community and for an accurate und standing of causes, as preliminary to social action or action the health officials, the vital facts are needed for narrow areas. The unit should be a sanitary area, not a political administrative one, as at present in most cities. It should permanent—which political areas are not—in order th frequent comparisons may reveal changes in health facts co nected with changes in nationality, sanitation, housing, inte gence, and other social conditions. This comparison m reveal the operation of causes. It should be small enough be relatively homogeneous in the chief conditions which aff health but not so small as to be inaccurate for statistical p poses. Most tables of vital statistics, as at present publish by city health departments, are utterly inadequate as a gu for social action and are of little use for scientific purposes

There is need of a research bureau in connection with t department of vital statistics whose function should be tabulate the vital facts by smaller areas and make the signi cant correlations and comparisons. What the health guardis

of a community wish to know is not the infant mortality rate of a whole borough or ward, but in what sections of the city is the rate high, what is the condition of the milk supply in that section, the sanitation, the housing, the intelligence and income of the families, the working conditions of the mother, if she works. Knowing these facts for separate smaller areas and comparing them may show very clearly the causes at work to produce either a high rate or a low rate of infant mortality. In some sections milk stations will then be established, with instruction of mothers and medical care of babies, the milk supply will be better guarded, and the sanitation improved. The result will be observed and the new death rate will show the success or failure of the effort. If the rate were to be calculated for an entire ward or borough, the result of the establishment of milk stations might show in the reduced death rate and yet some very bad health conditions, in certain small sections, still remain concealed by the very good conditions in other sections. Thus, to average results over wide areas with heterogeneous conditions is always dangerous and likely to mislead.

The health official or investigator does not care so much for the death rate from tuberculosis for a borough or an entire city because he wishes to ascertain where the rate is high or low and to find out why. He finds a high death rate from this disease in a section of the city with bad housing, dusty or otherwise dangerous occupations or with inadequate facilities for care of advanced cases, and with this information he is ready to work out a remedy. In this case also if the death rate were calculated over too large an area, the conditions needing remedy might not be revealed but rather concealed by the very good showing of the best sections. Although it is recognized that tuberculosis is an occupational disease, most of our city health departments throw no light, in their published reports, on the relation of deaths to occupation.

The public and the health officials are not interested alone in the contagious disease rate of the entire city, because, while the city may be making a good showing, some section of the city may need a contagious disease hospital very badly. To demonstrate this fact it would be desirable to examine the

sickness and mortality from contagious diseases in sma
areas. This would show the danger spots which really ar
peril to the city as a whole. In some sections the populat
may be so crowded that contagious disease quarantine
difficult to enforce, thus causing the rate to increase. In ot
sections the people may be engaged in work in their own ho
in the tenements and may be endangering the public hea
through contagion carried by the article manufactured in
home. These are the important facts to be known by
health authorities, and a rate for too large an area will
show the real situation.

There is need for coöperation in making vital statistics m
useful. It is clear that, if death and sickness data are collec
and tabulated by smaller sanitary areas, the population fa
must also be secured by these same areas in order to comp
a rate of death or sickness per unit of population. The fa
about the housing situation, room-crowding, home work
occupational conditions should also be gathered in these s
areas in order that comparisons may be made between mor
ity and morbidity data and other social and economic facts

Conclusion.

The present paper has attempted to emphasize the p
poses for which good vital statistics may be utilized and
results to which they may be expected to contribute t
part. Many of the present defects have been pointed out w
the idea of indicating how much more effective such fa
might be made if properly collected and tabulated and p
sented to a wider group of citizens, as well as to the hea
officials themselves. The need for more intensive study o
smaller areas of the facts concerning sickness, death, and
ability has become imperative for health departments, es
cially those of the larger cities where conditions are so comp
in order that effort and funds may be concentrated where t
are most needed and where they will yield the largest retu
in the preservation of health and efficiency and in the pro
tion of independence and welfare. The public must be e
cated in health problems by the facts made intelligible
them in order that their coöperation in the health movem
may be assured.

SOME CENSUS PUBLICATIONS AND CENSUS METHODS.

By Edward M. Hartwell, Ph.D., *Municipal Statistician, Boston, Mass.*

Speaking broadly, the statistical publications of the United States Government are repositories of information in bulk, placed in store for the benefit of such inquirers as may be skillful and patient enough to extract special data from them. They resemble stacks of pig-metal rather than packages of finished cutlery of assorted sizes, completely adapted to meet the demands of a diversified retail trade comprising skilled mechanics, as well as lumbermen and good housekeepers.

In comparison with State and Municipal statistical publications, those of the Federal Government conform more nearly to the state of the art as regards intelligible and helpful methods of tabular presentation, although there is abundant room for improvement in many volumes issued from the Government Printing Office at Washington.

Having frequent occasion to compile tables to meet the demands of individual inquirers as to the comparative standing of selected specimens of the most populous cities of the country, in particular respects, *e. g.,* taxable basis, corporate assets, tax levy, debt, industrial activities, financial resources, etc., I find the publications of the Bureau of the Census to be indispensable, and am abundantly grateful for benefits derived and derivable from their stores of information.

I am inclined to consider the Bureau of the Census as the central luminary in the statistical firmament of the country. But recent observations impel me to call attention to what appear to be an increasing number of spots displayed by that Sun. What follows is offered in the hope that such spots may ultimately grow so dim that the face of our chief luminary may appear immaculate to the *illuminati* as well as to the man in the street.

If one attempts to compile a table from the Bulletins for 1912 and 1913 of the Bureau of the Census, entitled Financial

Statistics of Cities, to show the relative standing of the most populous cities of the United States, as regards tax basis, receipts, payments, debt, etc., he will find him obliged to insert the selfsame figures under certain rubrica both years, in seven out of the ten cities, or to abandon attempt. Having occasion to construct a table on the l indicated, I was obliged regretfully to fall back on a ne paper Almanac for data regarding the year 1913.

If the Bulletin for 1913 contains any *caveat lector,* it escaped my notice. The nearest approach to such a warn appears to be the following statement in the Introductio the Bulletin for 1913, on page 7:

> The statistics in this bulletin all relate to fiscal years end between July 1, 1912, and June 30, 1913, except for cer independent divisions and funds of cities, in which the fi years of the city corporations closed between July 1, 1912, January 31, 1913.

The foregoing statement, although it does not say so terms, marks a change from previous years in the period ered by the tables presented for 1913. The nature of change becomes evident on comparing the following extr from the Financial Statistics of Cities for 1912 and 1911 spectively:

> The statistics shown in this report relate in each case the fiscal year ending between February 1, 1912, and J uary 31, 1913.
>
> These statistics pertain to the fiscal year of each mun pality, and of each division and fund thereof, closing betw February 1, 1911, and January 31, 1912, as shown in detai Table 23.

In the Bulletin for 1913, data for 199 cities of 30,000 inha tants or over, are tabulated, against 195 cities in 1912.

In 120 cities, or 60.3 per cent. of those embraced in the B letin for 1913, the fiscal year ended within the period Aug 31–December 31, 1912, while in 79 cities, or 39.7 per ce the end of the fiscal year fell in the period January 23–J 30, 1913.

The most frequent date of the end of the fiscal year December 31, 1912, in 102 cases, or 51.3 per cent. of all ca

ost frequent date was June 30, 1913, of which there
ses, or 11.6 per cent.

SUMMARY.

–March,	there were	28 cases, or	14.1 per cent.
–June,	there were	51 cases, or	25 6 per cent.
,	there were	79 cases, or	39.7 per cent.
, Aug.–Dec.	there were	120 cases, or	60.3 per cent.
l....................		199 cases, or	100.0 per cent.

5 cities embraced in the Bulletin for 1912, the end
l year fell within the period February 29–Decem-
2 in 189 cases, or 96.9 per cent. of all cases; the
., 6 cases, or 3.1 per cent., fell in January, 1913; in
as in January 31.

3, so in 1912, the most frequent date of ending was
1, in the case of 100 cities, or 51.3 per cent , and the
requent date was June 30, comprising 22 cases, or
t.

zing the ending dates of the fiscal years for the 195
ed in the Bulletin for 1912, gives the following:

END OF FISCAL YEAR—FELL IN:

–March,	in	21 cases, or	10.8 per cent.
–June,	in	49 cases, or	25.1 per cent.
–Sept.,	in	8 cases, or	4.1 per cent.
,–Dec.,	in	111 cases, or	56.9 per cent.
912,	in	189 cases, or	96.9 per cent.
913,	in	6 cases, or	3.1 per cent.
l	in	195 cases, or	100.0 per cent.

ent Director of the Census instituted the issuance
gment of the Annual Report on the Financial Sta-
ities "in accordance with the recommendation of
tistical experts appointed to devise methods of
he publication . . . of such annual reports as
d by this bureau." *

ve Bulletin 118, and the Eleventh Annual Report
the financial statistics of cities for 1912, and Bul-

transmittal of the Director, December 15, 1913, *ibidem* July 30, 1914.

letin 126 for 1913, with the twelfth report to follow, it may supposed.

Whether the change of year embodied in Bulletin 126 (wl consists largely of identical figures contained in Bulletin 1 was recommended by the several experts alluded to by Director (see above) does not appear. If it was, it wo seem that an extraordinary fondness for June 30, the enc the fiscal year of the Federal Government, must have blin the experts aforesaid to the effects of a change, which has sulted in precluding the possibility of making correct c parisons in respect to the financial standing of very m cities for the years 1912 and 1913, unless the supposedly fo coming twelfth report should be constructed on a differ basis from Bulletin 126.

Hastened publications, prepared to meet the supposed ne of impatient inquirers, unless they are provided with fin posts to indicate pitfalls, may, if persistently put forth, ca even the elect to stigmatize the Financial Statistics of Ci as misleading, to say the least.

Let us mark and digest a few of the most striking results (1) inserting identical total fiscal figures in correspond tables for 1912 and 1913; and (2) computing per capita av ages for two successive years by dividing identical divide by two different divisors, viz. (a) the estimated populatio of July 1, 1912; and (b) the estimated population as of J 1, 1913.

The Assessed Valuation of Property in New York, in Ta 1, page 19, Bulletin 118, is given as $9,177,495,629 for year ending December 31, 1912. In the corresponding ta in Bulletin 126, the entry is repeated figure for figure. different per capita figures are given, viz., $30.72 in Bulle 118, and $29.92 in Bulletin 126, the estimated populat used in computing the former being 5,064,237 for 1912, 5,198,888 for 1913.

The same procedure is carried out, not only as regards sessed Valuation, but as regards Property Taxes, Recei during the Year, Payments during the Year, Inde edness at End of the Year, etc., in the case of Chicago, P adelphia, Cleveland, Baltimore, and Pittsburgh, whose fi

year ended on December 31, 1912, and of Boston, whose year ended January 31, 1913. In only three cases do the absolute figures in the two bulletins differ consistently; to wit, for St. Louis, with its fiscal year ending April 8, 1912, and April 7, 1913; Detroit, with its fiscal year ending June 30, in both years; and Buffalo, with its fiscal year ending June 30, in both years. The population estimates differ correctly for the years 1912 and 1913 for each of the three cities.

The result is that the comparative per capita averages, and there are scores of them, are incomparable for all of the ten cities, excepting St. Louis, Detroit and Buffalo for the years in question.

Bulletin 126, for 1913, contains financial statistics for 199 cities. As regards 122 of them, or 62.6 per cent., the assessed valuation figures are identically the same as those printed in Bulletin 118, for 1912; while in 73 cases such figures differ. So the per capita averages of taxable basis, for any of the 122 cities, as set forth in the tables for 1912 and 1913 respectively, are not comparable with each other, although the divisors, *i. e.*, the population, estimated as of July 1, for 1912 and 1913, differ; since the dividends are the same for both years. Although I have not subjected all the per capita averages, as to taxes, receipts, etc., to the test applied to each of the 122 cities in respect to assessed valuation, in no less than 73 out of 100 instances which have been tested at random, the comparability of the published per capita averages is invalidated.

It may be remarked, in passing, that comparison of the Seventh and Eighth Reports on Financial Statistics of Cities, viz., for 1908 and 1909, discloses the fact that for 53 out of 158 cities included in the two reports, the valuation figures for individual cities in 1909 and 1908 are identically the same, and yield incomparable per capita averages for the two years, because their divisors, *i. e.*, the estimated population, viz., as of June 1, differ for the year in question.

The report for 1909 (see page 26) states that "The Statistics in this report refer to the fiscal year of each city, and of each division, fund, and account of the city, closing between February 1, 1909, and January 31, 1910"; but the reader is not notified that a change from the method of classifying the fiscal

years in the reports for the years 1902–1908 inclusive is
nalized by the aforesaid statement!

Manifestly, the Report for 1909, contains, as does the
letin for 1913, a mass, or perhaps mess is the more descrip
word, of misleading per capita averages.

A predilection for per capita averages is a marked cha
teristic of the ultimate consumer of comparative munic
statistics. Is it well that he should gorge himself on thi
under the impression that he is munching grapes?

In the Report for 1902, on Financial Statistics of Citie
find the following:

> According to the Bureau of the Census, the fiscal year
> is, in general, the one having six or more months in the cale
> year 1902, and thus most nearly coincident therewith.
> data secured by the Bureau of the Census for each dep
> ment and branch of municipal government are for a fiscal
> shown as such in the local reports and records.

The statistics for 1902 and 1903 were issued in one volu
The statistics for 1902 and 1903 related to cities having 25,
inhabitants or over; but those for 1904, related—as has ev
subsequent report and bulletin—to cities with a populatio
30,000 or over.

From 1902 to 1908, inclusive, the Bureau of the Census
sistently adhered to the definition of the fiscal year just quo
from the Report for 1902. Inspection of the reports sh
that the earliest ending of the fiscal year throughout the peri
i. e., for seven years, was July 31, 1902, 1903, etc., and t
the latest ending fell on June 30, 1903, 1904, etc.

In the period 1909–1912 inclusive, the fiscal years cove
by the reports closed between February 1 of the year for wh
the report was issued, and January 31 in the succeeding y
e. g., February 1, 1910–January 31, 1911. The change
1913 was tantamount to a return to the method followed in
period 1902–1908.

In the period 1902–1909, population was estimated as
June 1 in the year covered by the report. For 1910, the p
ulation enumerated as of April 15, 1910, was used. Si
1910, the population has been estimated as of July 1, for
year covered by the report.

The result of using three different kinds of population figures as divisors, and of using two different methods of fixing the fiscal year in determining the dividend in computing per capita averages, in the period 1902–1913, renders it necessary for one who seeks to compare the financial standing of a given city or a group of cities, by years, for the whole or a part of the period, on the basis of the published per capita averages, to exercise exemplary caution and patience, even when the fiscal year of a given city remained unchanged as has usually been the case.

The value of the per capita averages as to valuation, payments, debt, etc., might be considerably enhanced if the figure for estimated population were estimated for a median date in the fiscal year of each city included in the tables. Then if the dividend figures for that year were accurately stated, the resulting per capita averages would be comparable with the corresponding averages from year to year.

A comparison of per capita debt figures by years for Philadelphia in the years 1910–1912, brought out the following figures for Net Debt:

1910	$55.56 per capita.
1911	43.08 per capita.
1912	60.64 per capita.

The variation appeared to be too violent, and led to an attempt to test the figures. Computation of the per capita net debt of Philadelphia, using Philadelphia's estimated population for 1911 as the divisor and its net debt as dividend, gave $61.22, whereas $43.08 proved to be the quotient of Philadelphia's net debt, divided by Chicago's estimated population. It was then a simple matter to correct three other incorrect per capita averages under certain rubrics in the table, which, for convenience, are here embodied in a tabular statement.

Per Capita Averages, 1911—Philadelphia.

	As Printed.	Corrected.
Gross Debt	$50.88	$72.30
General Departments	36.42	51.75
Public Service Enterprises	14.46	20.55
Net Debt	43.08	61.22

It is not edifying to be made suspicious as to the accuracy of tables published by the Bureau of the Census, particularly when the printer cannot be made the scape-goat.

In this connection, it seems appropriate to call attention to the careless use of distributive or constituent per cents. that added together, equal more or less than 100.0. Instances of such carelessness, not to say slovenliness, are not far to seek in the publications of the Bureau of the Census. They occur so frequently that one must often recompute constituent per cents. in order to be certain that they amount to 100.0.

For instance, on page 412, Volume I, of the Thirteenth Census of the United States, Population-Table 44, there are 18 statements of the percentage distribution, by age groups of Indians, Chinese, and Japanese in the States of California, Oregon, and Washington, that purport to foot up 100.0. On testing the constituent per cents., one finds that there are:

7 cases in which the amount is 100.0
2 cases in which the amount is 100.1
1 case in which the amount is 100.2
5 cases in which the amount is 99.9
3 cases in which the amount is 99.8

18 cases, the range being 99.8–100.2

Again, on page 273, Table 21, Volume VII, Manufactures, Thirteenth Census of the United States, 12 series of per cents show the "Per Cent. of Distribution of Wage Earners in Manufacturing Industries," by Geographic Divisions. On testing one finds that in:

5 instances, the per cents. amount to 100.0
1 instance, the per cents. amount to 100.1
1 instance, the per cents. amount to 100.2
5 instances, the per cents. amount to 99.9

Other instances of like nature might be cited, even when the constituent per cents. amounted to over 101.0, but the cases cited corroborate the statement that one who wishes to compile perfect tables from the Census publications must test the data or trust to luck, at least where totalized per cents. are concerned.

REVIEWS AND NOTES.

Graphic Methods of Presenting Facts. By Willard C. Brinton. New York: The Engineering Magazine Co., 1914. 371 pp.

In this work by Mr. Brinton we have for the first time a volume devoted entirely to the discussion of graphic representation. The volume was evidently intended more for the uses of the executives of large business concerns who wish to know at a moment's notice the trend of business or costs than for the student of statistical methods.

The author evidently believes that every chart should tell its story entirely unaccompanied by analysis or text, giving the figures from which the chart was constructed. Wherever a chart alone is used for purposes of display in an exhibition it is but natural that the figures must be found on the chart if at all. Where a chart is used, however, upon one page of a book and upon the adjoining page is given the statistics from which the chart is drawn, it is not necessary that the actual figures should, in every case, be found upon the chart. In such cases the chart is used rather to bring out striking changes, or to aid one who is simply interested in the general movement, aside from the actual figures which serve as a basis for the chart. There are over 250 diagrams represented in the volume and the criticism attached to many of them by the author is that the actual figures should have been given on the chart. If the figures along the base line refer to years and upon the vertical axis refer to quantities and a simple dynamic chart is constructed, it is usual to allow the reader to form a close approximation of the magnitude of the variable at each year by referring to the scale at the left of the chart without including also the actual figures at the top of the chart. Where no text is used this method of including the figures in the chart may be advisable, but in the average work dealing with statistics the figures are given in a column for those students who desire them and then the general trend of the figures is shown on the chart. In cases where the statistical tables are included this would seem to be sufficient.

In Figure 144 the author takes decided exception to the method of chart used by the United States Census Bureau in distributing the population by sex, age, and marital condition. He constructs in Figure 145 the chart which he considers to be preferable. It is doubtless true that Chart 144 is exaggerated in that the same space is given to five years as to ten or fifteen years but with this correction it is doubtful whether the form suggested by the author is preferable to that used by the Bureau of the Census.

The chapter devoted to maps and pins is, perhaps, as satisfactory as any in the volume in that it gives various methods for overcoming difficulties which have confronted one who has ever tried to use this method of presenting frequency. The fifty pages of the book devoted to the presentation of charts for the use of the executive of a large corporation should prove of great value to the statisticians of these companies.

One of the best features of the book is the introduction of charts cove
a vast range of subjects and the detailed criticism of these charts.
many cases charts have been drawn to show the way in which the mate
might have been presented in a more satisfactory manner. The pag
large but this is necessary in order that the charts may not be too m
reduced in reproduction. It was, perhaps, necessary that the paper sho
be of the quality used in this book but it is unfortunate that the result
been to make the book so heavy that it is not easy to hold for continu
reading.

It seems to be the intention of the author that many of the rules given
graphic representation should be adopted as standards. Most of th
might well be adopted, but to a few of them some objection might be m
The warnings to inexperienced workers in this field deserve careful att
tion. Considered as a whole the author has done a satisfactory piec
work and one for which statisticians will be grateful. The book deser
reading by any one who is intending to use graphic representation, an
the rules given by the author were followed the principal mistakes wh
are so often made would be avoided.

Wm. B. Baile

The Construction of Mortality and Sickness Tables. A primer by
Palin Elderton and Richard C. Fippard. London: Adam and Cha
New York: The Macmillan Co. 120 pp. Eighty cents.

This little book is intended to serve the same purpose in its field as "
Primer of Statistics" published by W. Palin Elderton and Ethel M. Eld
ton. It gives in language which can be understood by the average s
dent the different methods of computing mortality and sickness tab
In a very few cases the algebraic formulæ are given in a footnote.
methods of computing tables both from the material collected from
experience of insurance companies and also from censuses and death reco
are given. In the concluding chapter the rates are included from the ea
Northampton table down to those which show present experience.
volume should be valuable as a first book for those who are intending
become actuaries as well as for the general students of statistics who w
to become acquainted with the process involved in the construction
mortality tables.

W. B. B

NOTE.

In his review of my "Money and Prices" in the March number of the QUARTERLY PUBLICATIONS, Professor Warren M. Persons makes several serious errors. In the first place, he confuses the arithmetic operations of addition and multiplication in a most surprising way. I had criticised the Pearsonian Coefficient of Correlation as a means for testing the relationship between two series of index numbers, because the coefficient is not changed if a constant is added or subtracted from each term of one (or both) series. Professor Persons admits the fact, but claims that it is an advantage for the Pearsonian Coefficient. He says that it is analogous to moving a curve of index numbers up or down to facilitate comparison. He seems to forget that moving a curve up or down or adding or subtracting a constant from a series of index numbers changes the relationship expressed. We must remember the significance of index numbers. Let us take a series of quantities represented by the index numbers in Column A.

	COLUMN A.	COLUMN B.
1900	100	60
1901	90	50
1902	110	70

The series means that the ratio of the quantity for 1901 to the quantity for 1900 is 90:100 or $\frac{9}{10}$; that the ratio of the quantity for 1902 to the quantity for 1901 is 110:90 or $\frac{11}{9}$. If we subtract 40 from each index number, we get the index numbers in Column B. Now the ratio of the quantity for 1901 to the quantity for 1900 is $\frac{5}{6}$ which is obviously not the same as $\frac{9}{10}$; and the ratio of the quantity for 1902 to that of 1901 is $\frac{7}{5}$ which is obviously not the same as $\frac{11}{9}$. If this fundamental point is grasped the objection to the Pearsonian Coefficient may be stated again. The Pearsonian Coefficient gives perfect correlation when there is a constant difference between the two series of index numbers as well as when there is a constant ratio between the two series. As was shown above, two series of index numbers with a constant difference between them do not display the same relative changes. Professor Persons surely knows the proper method of bringing curves representing index numbers closer for purposes of comparison. Each ordinate of one curve may be multiplied by a constant multiplier, since multiplying both terms of the ratio by the same number does not change the value of the ratio.

Moreover, the above objection applies not only to the ordinary form of the Pearsonian Coefficient of Correlation but also to the modification which Professor Persons intimates might well have been used, namely, Hooker's method. Therefore the use of the method is inadvisable, although it does consider the order in time of the items of the series. Hooker's method uses the differences between the successive items of the series in place of the differences between the items and the mean, in the computation of the coefficient. It is clear that the differences between the successive items of the series would not be changed if a constant were added to or subtracted from each term of the series. So, here again, the coefficient may give incorrect results.

Professor Persons has criticised the Degree of Correspondence with taking the trouble to understand how it is computed and the underly assumptions. In the first place, the Degree of Correspondence was vised primarily to be used with index numbers. Bearing in mind nature of index numbers, it seems reasonable to hold that there is per correspondence between two series of index numbers if they both mov the same direction and the relative amounts of change are the same. form of the Degree of Correspondence was used in which account taken only of the direction of the change and another form (used onl testing the proofs of the Quantity Theory of Money) where both the di tion and the amount of the change were considered. This latter form fessor Persons computed incorrectly in his examples. The operation w he describes of making the first terms of the two series equal must be peated for each pair of terms of the series, and not be done just once the whole series. Again, the examples by which Professor Persons s to show that the Degree of Correspondence is erratic, simply show tha has a different definition of perfect correspondence. He gives serie arithmetic progression or where the absolute changes in one are a g number of times the changes in the other, while, as was shown, the De of Correspondence is based on the idea that perfect correspondence m equal relative changes. Professor Persons's idea of perfect correspo ence seems to be merely that the relationship between the two series be expressible in an algebraic equation of the first degree. He has, of cou as good a right as anyone to make a definition of perfect corresponde But it is hardly fair to call the Degree of Correspondence, based on ano idea of perfect correspondence, erratic, simply because it does not fi definition. In the case of all the examples given on page 81 of the rev the Degree of Correspondence for the direction of the change would be since the direction of the movement is the same throughout. If, howe we consider the amount of the change as well as its direction, the De of Correspondence for the first series is +.65, for the second is +.12, for the third is +.21. These varying results show that the amounts o relative changes are different and not that the Degree of Corresponden erratic.

Professor Persons's point about the relation of the Degree of Corresp ence to the growth element or trend is not clear. Would he hav believe that there is no correspondence between two series because similarity is imputed to like growth elements? Moreover the Degre Correspondence can be used to test the correspondence between the tr of two series or the deviations from the trends of the series.

The flippant inquiry as to whether the circulation is increased by drin alcoholic beverages or vice versa, appears gratuitous. Exactly the s problem of which is cause and which is effect or whether there is any ca relationship would arise if one used the Pearsonian Coefficient of Cor tion.

University of Cincinnati.

James D. Magee.

REJOINDER.

The point at issue between Dr. Magee and myself concerns the reliability and accuracy of the second of the two methods which he uses to measure the correlation between two series of paired items. He says that the first method gives a "rough" measure of correlation, while the second is "a more accurate form of the degree of correspondenc." (QUARTERLY PUBLICATIONS, June, 1912, pp. 179–180). I agree with his characterisation of the first method but hold that the second method not only gives erratic and unreliable results, but that it can not be considered a measure of correlation at all. Our difference is not merely a difference of opinion as to what constitutes perfect correlation.

Dr. Magee describes his "more accurate" form of the Degree of Correspondence as follows: "The percentages of increase or decrease for the corresponding items are computed, and the smaller is divided by the larger. After this number has been computed for each pair of values, the arithmetic mean is taken and the result gives the Degree of Correspondence in the form which considers the amount as well as the direction of the changes" (Money and Prices, p. 7).

Let us apply this method to the following hypothetical series:

YEAR.	A.	B.	C.	D.
1900	100.0	100.0	100.0	100.0
1901	101.0	110.0	101.0	110.0
1902	102.0	121.0	202.0	121.0
1903	103.0	133.1	181.8	119.8
1904	104.0	146.4	163.6	0

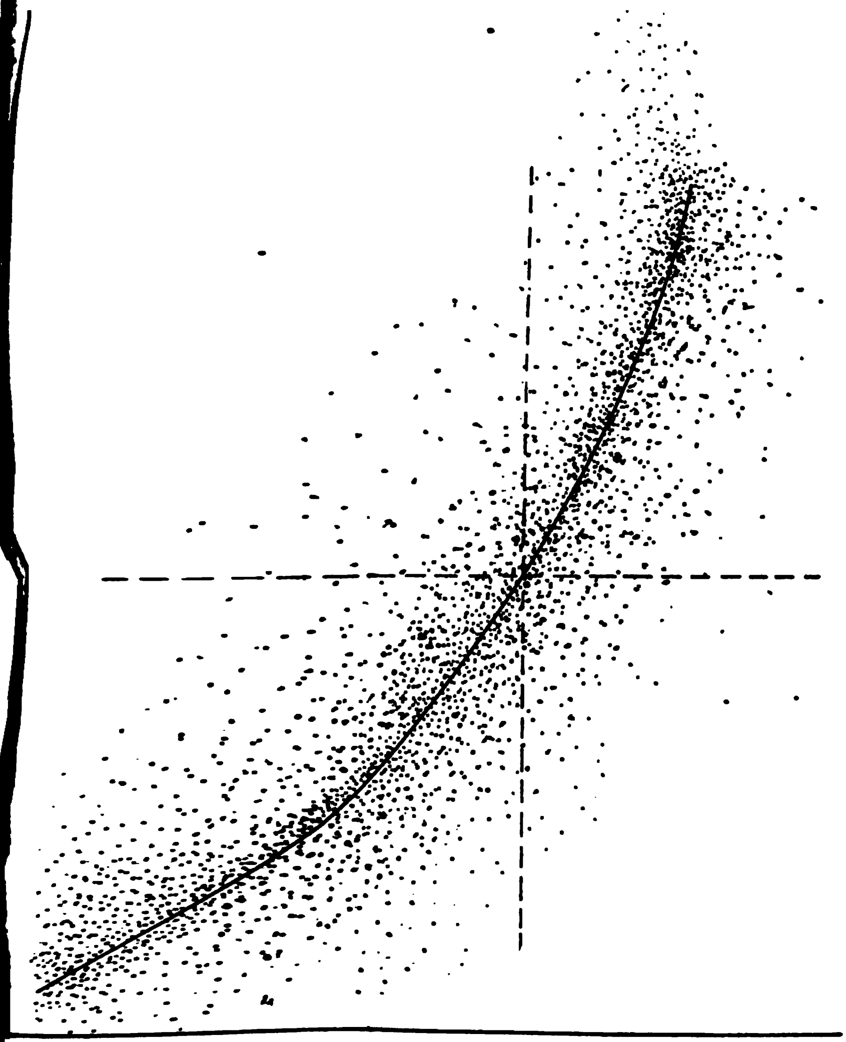
Columns A and B are increasing geometrical progressions, *i. e.*, each item is obtained from the preceding item by adding 1 per cent. and 10 per cent., respectively. The direction of the change is the same throughout the series A and B. The ratio of the percentages of increase is constant and equal to $\frac{1}{10}$, and the arithmetic average which gives the Degree of Correspondence is, therefore, $\frac{1}{10}$. If we should make the computation for series A and another geometrical progression with 2 per cent. as the rate of increase the Degree of Correspondence would be $\frac{1}{2}$. It is evident that two series which move together, each having a constant rate of change, may be built up to give any desired value to the Degree of Correspondence. It appears, then, that the coefficient measures not correlation but average ratio of the rates of change. However, interchanging the rates of change for corresponding items does not affect the result. To illustrate: Column C is constructed by adding 1 per cent., then 100 per cent., and subtracting 10 per cent., then 10 per cent.; column D is constructed by adding 10 per cent., then 10 per cent., and subtracting 1 per cent., then 100 per cent.

from or to each item to get the succeeding item. In each case the rati
of the percentages is $\frac{1}{10}$, making the Degree of Correspondence betwee
series C and D equal to $\frac{1}{10}$, which was the result obtained for series
and B.

It is clear, then, that Dr. Magee uses the word "correlation" to indicat
something quite different from the accepted connotation of that term
A. L. Bowley has well expressed the generally accepted meaning of correla
tion as follows: "When two quantities are so related that the fluctuation
in one are in sympathy with the fluctuations of the other, so that an increas
or decrease of one is found in connection with an increase or decrease (c
inversely) of the other, and the greater the magnitude of the changes in th
one, the greater the magnitude of the changes in the other, the quantitie
are said to be *correlated*" (Elements of Statistics, p. 316). Any coefficien
of correlation, therefore, when applied to two time series should measur
their *synchronization;* it should be large if fluctuations occur at the sam
time and if small or large fluctuations of one series occur with relativel
small or large fluctuations of the other series. The Pearsonian Coefficien
computed in the usual way for series A and B would be very high and pos
tive, while for series C and D it would be low and negative.

The Degree of Correspondence does not give the extent of correlation
but it does give the average ratio of relative change, a distinctly differen
concept. If we let x represent any item in the A column, y the correspond
ing item in the B column, and n the number of years from 1900, then $x = 10$
$(1.01)^n$ and $y = 100\ (1.10)^n$, giving $\frac{\log x - 2}{\log 1.01} = \frac{\log y - 2}{\log 1.10}$. The last equatio
states that for every increase of 1 per cent. in x there is an increase of 1
per cent. in y. It is to be noticed that this is a linear relation between lo
x and $\log y$ so that if the Pearsonian Coefficient of Correlation be compute
for the logarithms of the numbers in columns A and B it will be $+1$, indi
cating the maximum degree of direct correlation. This, of course, result
from the assumption that the corresponding items of the series A and
have an exact mathematical relationship existing between them, in thi
case the compound interest law. If we should use the corresponding value
of columns A and B as coördinates the points thus located would be upo
and determine a curve similar to the solid line in the accompanying diagram
the curve being the curve of regression. If, as would be the case when w
are dealing with questions of correlation, the items of column A chang
approximately 1 per cent. while the corresponding items of column B chang
approximately 10 per cent., then the plotted points would be located i
proximity to the curve. The Pearsonian Coefficient of Correlation, com
puted for the logarithms, gives a measure of the closeness of grouping of th
points about the compound interest curve, the curve of regression in thi
case.

Dr. Magee has confused the idea of correlation (closeness with which
the actual corresponding fluctuations obey any law which we may select)
and the law which we select for the test. It happens that the law usually
selected is the simplest, that is, the question we usually put is this: Does



an increase or decrease of a units in one series correspond to an incre decrease (or inversely) of b units in the other series? In the case our curve of regression becomes a straight line and the Pearsonian cient of Correlation measures the closeness of grouping of points this straight line (see Yule's Theory of Statistics, p. 202).

Let me call attention to the fact that Dr. Magee's two method widely different results when applied to the same pair of series. Degree of Correspondence for Kemmerer's figures for relative circu and general prices comes out +0.48 and +0.20, respectively. When is conflict Dr. Magee abides by the result of the second method, t which I have criticized.

In conclusion it may be pointed out again that where yearly figu correlated, such as the indices of prices of nine railway bonds on th York Stock Exchange and the net deposits of New York Clearing banks, like growth elements may be the cause of the high Degree of spondence obtained; the risk element in the bonds may be steadily d ing as population increases along the railways and the net deposits steadily increasing because of the growth of New York banks due i to the growth of New York City.

Warren M. Pers

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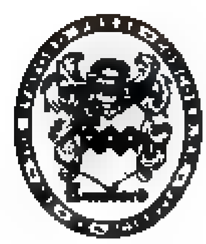

CONTENTS.

AMERICAN STATISTICAL ASSOCIATION

NEW SERIES, No. 109. MARCH, 1915.

SOME STATISTICAL IDEALS.*

By John Koren.

Amid the pressure, never more clearly accentuated than now, of problems that reach into the fundamentals of our social and national existence, it may seem rather remote to speak about statistical ideals before an audience of economists and sociologists, containing but a sprinkling of professed statisticians. It would be far-fetched were I to indulge in speculations about the ultimate possibilities of a sublimated application of the statistical method. Some problem peculiar to the science of statistics could properly be discussed, but it might interest only a few. Although being concerned with ideals, I intend to touch upon practical subjects of general importance. Economists, sociologists—all of us—have at least this in common that we require that ground-work for theory as well as for practical endeavor which statistics provide. Gradually a recognition of this, the universal need of fact-bases, is becoming more and more pronounced among us. The statistician welcomes this trend toward finding out the truth about things, instead of fancifully speculating about them, for it marks an approach to the ideals he professes.

The general attitude towards statistics, and one perhaps especially characteristic of this country, is curiously paradoxical. We cry aloud for facts; there is a voracious and indiscriminating appetite for figures, or rather for the nourishment they afford to argument and propaganda; statesmen, teachers, preachers, publicists, and men in the street exemplify it. It is a dyspeptic appetite, if you please, because of the ill-assorted wares upon which it feeds. On the other hand, there is an almost equally common and more or less outspoken distrust of statistics or of the widespread application of the statistical

*Presidential address at the annual meeting of the American Statistical Association, Princeton, N. J., December 28, 1914.

method as a means of obtaining working knowledge. Wh-
it roots in a lack of appreciation of facts or frequently sig
merely an aversion to the alleged cut-and-dried, tedious
esses by which statistics are evolved matters not. Ther
common state of mind in this country which is typified b
remarks of a certain Turkish official in a reply to an E
seeker after statistical information:

"The thing you ask of me is both difficult and us
Although I have passed all my days in this place, I have ne
counted the houses nor inquired into the number of th
habitants; and as to what one person loads on his mule
the other stows away in the bottom of his ship, that is no
ness of mine. But above all, as to the previous history o
city, God only knows the amount of dirt and confusio
infidels may have eaten before the coming of the swo
Islam. It were unprofitable for us to inquire into it. O
soul! Oh my lamb! seek not after things which concern
not! . . . God created the world and shall we liken
selves to Him in seeking to penetrate into the mysteri
His creation? Shall we say behold this star spinneth ar
that star, and this other star with a tail goeth and come
so many years? Let it go! He from whose hand it cam
guide and direct it!" *

One can sympathize with contempt for a useless prying
things that concern us not, which unfortunately marks
little of so-called social investigation. There is much statis
delving which merits ridicule because it simply deno
stale industry applied to matters that profit no one, an in
ity to distinguish between essentials and unessentials, c
unwholesome curiosity about the purely trivial. Yet the
alent disrespect for that fact presentation which we
statistics has a deeper cause. It is not solely the too freq
neglect of the wise maxim that only persons of good re
should be permitted to officiate as statisticians, which acc
for low standards in valuing statistics. Nor is the tr
only with the inaptitude or unintelligence of the consume
statistical products.

Perhaps we shall get closer to the truth by asking

* From Sir A. Layard's "Nineveh and Babylon."

there enough conscientious endeavor to cultivate the science of statistics? Let the schools and universities answer. Where can one turn, confident of getting competent training as a statistician? I mean not merely a smattering of theory or cleverness in making diagrams, but a training that fits a man for the difficult task of mass-observations of fact, so that he is equipped to meet demands in positions of high responsibility in public or private service. It were ungracious to probe far and deep for an answer. We can find a sufficient one in the circumstance that as a rule our professional statisticians are self-taught or get their training, which often may be imperfect and one-sided enough, by the aid of others whose only schoolmaster had been experience. In an exceptional office one may have the good fortune to come under the tutelage of a man of broad views and unswerving high aims, and at least imbibe certain statistical ideals. But this is a rare exception.

The uncontrovertible truth is that our universities do not take the lead in this respect which rightfully belongs to them. The stepmotherly treatment generally accorded statistics as a discipline, I need not specify. There are the curricula—you know them better than I—they speak for themselves. Where is the leadership of our schools of learning in actual statistical work? Take by contrast a country which is not precisely popular in the United States at the present time, but which at least is giving abundant evidence of marvellous efficiency. One may venture so far as to say that its efficiency rests in no small part upon training in assembling and interpreting facts. In Germany, it is the Herr Professor and Doctor, himself trained in the schools, who directs statistical activities whether at the head of national undertakings or as the principal of municipal statistical bureaus or in other similar capacity. Of other countries, France, Italy, Austria-Hungary, and many smaller ones, the same is true, if perhaps in a lesser degree. It would be an evasion of the issue to say that our conditions do not afford opportunities of a similar character. The truth is rather that our universities do not provide men to seize the opportunities at hand. At bottom lies the fact that the training is not afforded which fits for leadership. Only the unusual man is capable of attaining it without the

preliminary guidance which might equip those of lesser nat
talent.

Perhaps one reason, but hardly an adequate excuse, for
neglect of statistics in our learned schools is the difficulty
teaching the subject. Yet it can be done successfully so a
serve the double purpose of training statisticians and prep
ing others to become discriminating consumers of statist

It is an ungrateful task to point out these commonp
grievances; but if we are to speak of ideals it is neces
first to account for some perfectly obvious shortcomings of
present day. The unreasoning attitude many take toward
tistical work is all too explicable. The spurious article parad
under the name of statistics circulates without let or hindra
Perhaps later on its lack of genuineness may be revealed,
then the mischief is done. It is not merely a question of hu
ing down these statistical untruths, an almost hopeless ch
but of their effect upon our habits of thought. Then the
a singular superstition that anyone, no matter how c
pletely lacking in training, and even ordinary aptitude,
be employed in pretentious statistical undertakings.
schools of learning are not guiltless in this respect, nor
the private organizations that profess a certain leaders
Under such circumstances it is hardly becoming to bl
severely the appointive powers when they so freque
place men in offices of high responsibility to whom statis
is a meaningless term.

It is not open to dispute that, speaking generally, we ha
statistical output which is as lacking in quality as it is t
appalling in quantity; that a multitude of so-called inve
gations show still-born results; and that other statistical
quiries simply weary the student because they yield noth
worth while and therefore fail to instruct. What wonder t
there is more or less articulate protest against the waste
time and effort in statistical work, coupled at times with
emphatic condemnation of efforts to pry into affairs that c
cern us not! Why wonder at the prevalent skepticism tow
statistical statements, although some of those who exemplif
would by no means be deprived of the opportunity for mak
such statements! And, lastly, what wonder that the pro

sion of statistics has not quite attained the honorable place in this country which is its right! Much of this may sound trite and elementary but must be reiterated until better conditions emerge.

Here, then, are indicated some of the modest statistical ideals toward which we should strive. The basic requirement is that the schools of learning should do their duty in affording a training that will enable men not only to become students of statistics but to engage in the profession of statistics. The demand for qualified workers grows more and more insistent, while efforts to meet it continue to lag. The urgency of the situation is almost too patent for discussion. Under the tutelage of the universities as well as of statistical offices of recognized standing, the pretentious tribe of incompetents who bring the very name of statistics into disrepute would be supplanted by trained observers of and earnest seekers after facts. We should no longer witness the distressing spectacle of well-meaning but untrained men and women being set at tasks which profit not and spell waste of public and private money. The profession of statistics would attain that dignity and public confidence to which it is entitled. And under the conditions sketched it seems reasonable to expect that the present attitude of the consumer of statistics might be happily modified. He would learn to cultivate an appetite for wholesome things and be saved the ills of a statistical indigestion which now only the wary can escape. Lastly, there would be put at the disposal of men of the learned professions the material that is so necessary in much of their work.

If there is abundant reason in this country to ask forgiveness for statistical shortcomings, there is as ample cause to seek for wisdom and intelligence in order to do much-needed work well. To enumerate all of it would be tedious and a repetition of the fairly obvious. I will, however, venture one suggestion. We must learn to show greater patience in acquiring elementary facts in the wide domain of statistics. This is one of the greatest needs; the refinements can wait. Our proneness to reason and act, through legislation and otherwise, upon insufficient fact bases, to make a fetish of theories without subjecting their value to the simplest test, do not make for intelligent progress, no matter what political or social problem is involved.

Passing by the wide fields of fact which need to be indus
ously explored, I wish to direct your special attention to
question of organization for statistical efficiency. With
doubt a large part of the existing confusion, and the unc
dinated and often disappointing results of much statis
work are to be sought in defects of organization. I an
course here referring chiefly to official statistical offices,
am not concerned with details but with certain general p
ciples. Let me illustrate by an example. The tremend
statistical machinery operated by the federal governmen
known to us all. Its growth has been somewhat haphaz
the parts do not all fit; there is duplication of work, unneces
friction, and waste. In short, it is not the effective engi
should be and can be made. Various reasons may be
signed for this. Statistical offices are sometimes filled
an eye to politics rather than to fitness; proven ability
not lead to promotion or adequate compensation. But
more vital has been the absence of a competent guiding h
in shaping the activities to be set in motion.

The situation demands improvement. And the me
Let us assume that there were created by Congress a Cen
Statistical Commission composed of the heads of Governn
departments and bureaus that have important statistical w
to do, reinforced by a specified number of men drawn f
societies like the American Economic, Sociological,
Statistical Associations, the Actuarial Society, and perh
other learned organizations, and with other members
quately representing the professions of medicine and law
special branches of learning like biology. Assume also
such a Commission be given adequate advisory power
deal with all that pertains to statistical organization, p
ning, and work within the federal government. Ought it
to become a powerful agent for smoothing out defects, rai
standards, cultivating the now bare spots in the statist
fields, and thus bring us a little nearer the ideal service?

I offer you no new idea. Suggestions similar in nature h
already been brought to the attention of officialdom.
outside of Germany and England there is to my knowledge
a single country without a central statistical commission u

which uniformly men of the highest distinction and attainment are known to serve.* I cannot find any valid reason for believing that we should fail if the experiment were tried. That anyone among us should refuse the honorable place upon such a commission is unthinkable. But unless the impulse toward its establishment comes from us, we shall expect it in vain.

Hitherto we have as a body largely been content with fault-finding, which has had its uses, no doubt, but of course has lacked constructive force. The stake is too large to permit us any longer to remain outside as passive critics. We have a duty and cannot divest ourselves of responsibility.

The principle of participation in official statistical work, just alluded to, is as applicable to state and municipal activities as to those of the federal government. At least in some states there are men and institutions sufficiently qualified to exercise an advisory leadership in statistical undertakings which too often miss fire for want of it. Just now, for instance, several states are preparing for censuses. Whether their results will measure up to expectations should be our concern from the moment of the first preparation for the work. Here and there are signs of a new feeling of responsibility in these things, but concerted action is still wanting. Has not the time come to organize for it? I address this question chiefly to members of the American Statistical Association, but also to the economists and sociologists.

I am conscious of having taken the unwelcome part of a critic, that I have dwelt on somewhat obvious elementary conditions and needs, perhaps with a tinge of preachment. Probably I shall be forgiven for the sake of those still unattained ideals which we all profess and toward which, I trust, we are slowly moving.

*In Germany, many of the different states possessed competent statistical organizations before the Empire brought them into closer confederation. The Imperial Statistical Office largely supplies the need of a Central Commission. So far as England is concerned one may modestly hold that such a Commission would be useful.

A STANDARD ACCIDENT TABLE AS A BASIS F COMPENSATION RATES.

By I. M. Rubinow, Ph.D., *Chief Statistician, Ocean Accident and G antee Corporation, Ltd.*

The rapid growth of compensation legislation in this cou has created a sudden demand for accident statistics which American statistical literature was utterly unable to m The majority of American compensation acts are based u private compensation insurance which may be solvent when based upon accurate premium computations. The man method of assessment insurance for industrial accid can only be successful when built upon a compulsory or ization of the insurance carrier. This method has been lowed in a few states only, notably Washington and V Virginia. The difficult problem of calculating proper rate compensation insurance, rates which should not be excessi high and yet sufficient to meet all the slowly develo charges resulting from accidental injuries, found the busi of casualty insurance somewhat unprepared. The deve ment of compensation legislation was so precipitated an unexpected that there was little time to prepare the neces material.

As compensation was a substitute for the discredited sys of employer's liability, so insurance of the obligations cre by compensation acts developed out of the methods of emp er's liability insurance. Naturally enough the casualty c panies (that is the insurance companies writing so-called cellaneous lines, including almost all lines outside of fire and marine, liability insurance being the most impor of these) were forced to rely upon the experience under bility insurance for making hurried estimates as to the p able cost of accident compensation. It became evident soon that the two systems were entirely different, not from the point of view of social justice, but also from tha insurance practice. The experience under one was of l

service in shaping methods for the conduct of the other branch of insurance. For the benefit of statisticians not familiar with the conditions of employer's liability insurance these may be briefly stated here:

An employer's liability insurance contract obligates the insurance company (for a certain consideration stipulated in advance and known as the premium) to reimburse the insured employer in case he is called upon to pay damages for accidental injuries sustained by his employees in accordance with the verdict of a court. In practice the insurance company, in order to reduce the possible losses through such court verdicts, undertakes to defend the suit and also endeavors to settle amicably out of court as many suits, or claims threatening to become suits, as possible. Naturally, the losses, while depending upon the frequency and severity of the injuries sustained, do not at all bear any definite relation to them. Perhaps in an equal degree they depend upon the stringency of the liability legislation of each particular state, upon the nature of the court decisions as to the validity of the "Three Defenses," upon the skill of the attorneys in defending suits and arguing appeals, and upon the efficiency of adjusters to settle a large number of claims before the injured employees are tempted to bring suit against the employer.

In compensation insurance the cost in any one industry evidently depends entirely upon the number and character of the injuries occurring in that industry, as well as upon the amount of compensation granted by the particular law. Under employer's liability laws there frequently is no logical or equitable relation between the character of the injury and the cost of settlement. Very much more depends upon the existing legal evidence as to the cause and the manner of occurrence of the accidents. For this reason the legal features of the cases are much more carefully studied than their surgical or medical features. Every large casualty company had some sort of a statistical organization even before the advent of compensation legislation, but the statistical work done approached the problem from a different point of view. The experience studied dealt largely with the relations between money losses paid and premiums collected, or the exposure in

dollars of pay roll, so as to obtain either the loss ratio or
so-called pure premium.*

Very seldom were the accidents reported studied,
almost never were their physical nature or their econo
effect upon the earning capacity of the wage-earner conside

This experience for numerous minute subdivisions of in
try was almost the only available source of information u
which to build compensation rates. No wonder then that
rates at first proposed were in the nature of guesses only,
many of them went far beyond the mark. An effort was m
by the central rate-making organization of the casualty c
panies to utilize the experience of the so-called workm
collective insurance.† This is a form of insurance more clo
approaching workmen's compensation because it covers
ployees of certain establishments for all accidental occu
tional injuries irrespective of fault, and the benefits are sub
to a definite schedule, though very much more limited than
schedule of benefits under compensation. The records of
form of accident insurance, had they been properly kept
had there been enough of them, would have presented v
valuable information as to the number and nature of accide
in separate industries. Unfortunately the volume of this b
ness available to the rate-making bureau was much too sm
perhaps a paltry $100,000,000 of wage exposure, equal to s
200,000 employees working for one year. This amou
divided into many different industries, leaves very little
depend upon for most independent industries. Besides,
actual records were very far from satisfactory as to the nat
of the injury and duration of disability. Instead of the a
dent experience under these collective policies, their loss ex
rience was utilized as a starting point and the rates charged

* By loss ratio is meant the percentage proportion between losses and premiums. By pure pre
is understood the cost of losses per hundred dollars of wages paid by the insured employer to his empl
This method of computation, as well as the reference of all computations to the exposure of wage
rather than persons employed, is unsatisfactory from the point of view of theoretical accident stat
but is explained by the conditions of the business. Ideal accuracy would undoubtedly require th
number of employees and the time spent in work be computed, but there are so many practical diffic
in the way of accurate determination of these facts by thousands of independent employers th
rough and ready measurement of the risk by the volume of pay roll in practice presents much more
rate results.

† See article, "Establishing Rates for Workmen's Compensation," by Theodore R. Gaty, *Market*
and Chronicle, January 11, 1913.

insurance under that form of contract. But as these rates were originally computed from very limited data, the building could not be stronger than the foundation. There is no doubt that the dissatisfaction of employers with the conduct of compensation insurance during the first experimental years was largely caused by the absence of accurate data from which scientific rates could have been built.

The question has often been asked why the voluminous and carefully studied accident statistics of European countries has not been utilized at this critical moment. Germany, for instance, having begun insurance against industrial accidents nearly thirty years earlier, possesses almost a library of statistical material on this problem. There were several reasons why that experience was not and could not have been utilized.

To begin with, a widespread feeling of skepticism in regard to all European experience may often be found even among students of social conditions, and is especially strong among practical American business men. While in life insurance mathematically accurate data have been in use for many decades, casualty insurance is still managed very largely as a business and very little as a science. Knowledge of foreign statistical sources among casualty men, with a few notable exceptions, was rare. It was easy to argue that European statistics were utterly inapplicable because, as everyone would readily admit, our own industrial activity is so much more hazardous, accident prevention less known, factory inspection less efficient, and for these reasons the number of industrial accidents is very much greater. Moreover, the various European compensation acts are quite different from each other, especially in their provisions as to the prescribed scales of compensation, and the American acts still more different from the European acts, and unfortunately, from each other.

Furthermore, European accident statistics are published and studied according to many different methods. Efforts to establish a uniform system of accident statistics in Europe though advanced by the International Statistical Institute have not as yet been successful. The definition of what constitutes an accident, the distribution of accidents into groups according to their surgical and economic results (that is as to

the physical nature of the injury and as to its effects upo
earning capacity of the victim) the classification of indu
used, etc., all this is different in every known statistical so
Finally, the statistics published are in such a form as to be
more useful for general social purposes than for the com
tion of rates. It may be very instructive to know tha
accident frequency in the metal working industry is 5
cent. higher than in the woodworking industry, but the i
ance carrier does not undertake to insure either the one o
other. Insurance must be written and rates quoted fo
tain industrial establishments manufacturing definite ar
or for contractors performing definite jobs, and no Euro
source presents its data in sufficient detail to meet the dem
of the practical casualty underwriter for specific inform
in regard to some 1,500 different classifications of indu
undertakings. All this explains why it is impossible to
directly upon European sources for the necessary informa
Does it follow, therefore, that all European experience is
gether worthless to help meet the difficulties arising out o
application of compensation acts in this country durin
first few years?

In an article published early in the history of compensa
the writer suggested a method for computing compens
rates by means of utilizing all possible American and Euro
statistics. The method suggested may be outlined by m
of the following quotations:

> All scientific rates must include the following three elem
> first, agent's commissions; second, expenses of central ad
> istration; third, the pure cost or pure premium. In the m
> of workmen's compensation in the United States, the
> two of these items depend entirely upon American condit
> and are easily controlled and computed. All the uncerta
> all that is still obscure, lies in the third item—the fact
> pure cost or pure premium.
>
> Now, the pure premium itself may be resolved into
> factors: first, the accident rate; second, the proportion o
> various classes of accidents (that is as determined by degr
> disability, duration of disability, etc.), to the whole numb
> accidents; third, the compensation scale to be used.

* Arriving at the Cost of Workmen's Compensation in the United States, *Market We Chronicle*, June 22, 1912.

Summarized, the plan calls for the following operations: first, determine the rates of accident in the various industries on the basis of American experience; second, determine the relative proportion of fatalities of permanent disability cases, partial or total, and the relative duration of temporary cases, on the basis of European experience; third, apply to the results thus obtained through the combination of American and European experience the various compensation scales of the various American compensation laws.

The first suggestion outlined above, as to what may be termed accident frequency, had in view a possible utilization of the many thousands of accident reports transmitted to the casualty companies by their policy holders. For a careful study of accident statistics these reports are of little value because of their faulty character, but it did seem to the writer that the simple count of these reports for each separate industry might give a sufficient indication of relative accident frequency.

The most important part of the plan is contained in the second suggestion that European experience might be utilized for the purpose of distributing accidents into groups according to gravity. This suggestion has found enthusiastic support among some actuaries and insurance statisticians, while it has been severely criticized by others. One may perhaps be excused for stating this suggestion in the terms originally used:

> It is when we come to the proportion of the various classes of accidents that we meet with the greatest difficulties for here we have almost no available American experience at all . . . we must look for light elsewhere . . . until we have gone far enough with workmen's compensation in the United States to have our own experience. . . . As regards this problem of the nature and effects of injuries . . . there can be no great differences between one country and another. An examination of the statistical material of various countries shows that there is practically no variation from country to country. It appears that whatever its nationality, the human machine is a human machine, and that its average resistance to injury and its average speed of recovery from injury vary very little.

As regards the first suggestion that the accident frequency of various branches of industry be ascertained from all records of casualty companies dealing with liability insurance, it has

never been practically utilized. With the rapid accumul
of experience under compensation insurance, the necessit
making use of this method is passing away. While the fa
of the casualty companies to make use of the plan prop
seems unfortunate because it might have prevented
errors, this at present is a matter of purely historic intere

The second suggestion as to the method of studying
dent gravity was destined to play a more important pa
the development of compensation legislation and insur
Though extremely simple in itself and almost obvious to
one who has made any study at all of foreign accident stati
it appeared like a new scientific clue to many actuaries
were groping for some practical method of computing the
of compensation. It was impossible to make any direct
parisons between the American compensation scales and
of Germany or France and determine in that way the rel
cost of the different acts. The differences in the scales
so many that it was necessary to weight each difference in
provisions in accordance with the frequency with whi
might come into play, and the comparative share of each g
of accidents in the total cost of all.

As far as the writer's information goes, Professor A
Whitney, at that time consulting actuary of the Calif
Industrial Accident Commission, was the first to make u
the above suggestions, and apply a hypothetical distrib
of accidents based upon European experience to this prob
to determine the probable cost of the proposed Calif
Acts as compared with the then California Act and with
acts in existence at the time.* Another Californian stu
of the problem, Mr. A. H. Mowbray, a consulting actuary
was chairman of the Social Insurance Committee of the C
monwealth Club of San Francisco, has also applied this me
to a comparison of the proposed California Act with the e
ing Illinois and Massachusetts Acts.† Mr. Mowbray ma
careful analysis of the statistics of various countries as

* See "Memorandum concerning a proposed scale of Compensation Benefits to be paid to W
injured through industrial accident now under consideration by the Industrial Accident Board
fornia," 1912.

† See a typewritten memorandum, entitled "A Suggested Basis for the Determination of Comp
Costs of Different Compensation Schedules, and Some Comparisons thereof."

lished in the twenty-fourth Annual Report of the United States Commissioner of Labor, and concluded that "the close agreement" between these various statistical data "seems to strengthen the case in favor of Mr. Rubinow's hypothesis."

Thus the plan outlined above was never used in its entirety for the purpose of computing compensation rates, but it proved to be quite adaptable to the specific purpose of ascertaining the difference in the cost of different compensation acts, or what may be called a differential between different acts.

While the efforts of Professor A. W. Whitney and Mr. A. H. Mowbray were of theoretical importance only and did not serve as a basis for rate computation, the first practical application of the method occurred in connection with the New York Compensation Act, passed by the New York Legislature in December, 1913, to go into effect July 1, 1914. The act conferred upon the New York Insurance Department the duty of passing upon the adequacy of the rates to be charged for compensation insurance. The declared purpose of this legislation was to protect the policy holders as well as the injured employees against the possible danger of insolvency of the insurance carriers, which might result from inadequate rates. In order to act intelligently under the new power conferred upon it, the insurance department faced the problem of establishing some standard measure of rate adequacy at the time the New York Compensation Act, different from all other acts and more generous than most of them, was going into effect. The problem appeared extremely difficult, almost insolvable. A comparison with the rates in force in other states at the time did not seem helpful, since these rates were subject to many criticisms. Fortunately, the Insurance Department of Massachusetts, which had called upon the insurance companies early in 1914 to furnish results of compensation insurance in that state, was able to prepare the experience (that is, the relation between losses sustained, premiums received, and the wage exposure) on some $500,000,000 of wages by separate industrial classifications. Thus some basis for calculation of pure premiums was available. The rate-making bureau of the casualty companies agreed to utilize this volume of experience in computing New York rates.

The writer was consulted by the actuaries of the New Y
Insurance Department and was asked to suggest a metho
comparing the cost of the two acts. The method sugg
embodied the principles above outlined, that is, a sep
valuation of a given series of accidents, reflecting the no
distribution according to gravity, under both acts, and
comparison of the resulting cost. By a happy coincidenc
preliminary results of the tabulation of industrial accid
in Massachusetts for the first year of operation of the com
sation act (July 1, 1912, to June 30, 1913), made by the In
trial Accident Board of that state, also appeared at the
The 90,000 accidents reported in Massachusetts were ther
used as a basis for the computation.

The problem assumed the following form: how much w
these 90,000 accidents cost according to the Massachusett
and how much according to the New York law, a propo
between the two amounts being the true differential bet
the laws of the two states.

But while the Massachusetts report was extremely u
it did not analyze its material in sufficient detail to enabl
to compute the cost accurately. Especially was the r
unsatisfactory in regard to the question of permanent pa
disability, the number of such cases, and the degree of
ability resulting. As the New York Act is extremely li
in regard to such cases, they represent a very substa
part of the entire cost of compensation, and some conce
as to their number and gravity was absolutely neces
For this purpose very detailed figures of Austrian and Ge
accident statistics (analyzed in the twenty-fourth An
Report of the United States Commissioner of Labor)
recommended. This was perhaps the first formal applic
of European experience to American compensation insur

The discussions accompanying the adoption of the
York compensation rates emphasize the great necessit
some scientific method for computing such rates for all
pensation states. In most other states where compens
acts were in operation grumblings were heard against ex
tant and inequitable rates. Comparisons of rates in diff
states for identical industries were made by industrial acci

boards as well as private employers, and justifications for the differences disclosed were urgently demanded. The difficulties created by the co-existence of so many different acts were obvious. Not only did this make the work of preparing rates for each state so much more difficult, but it also vitiated comparisons of experience unless some method of equating these differences were applied.

To Professor A. W. Whitney (who became general manager of the Workmen's Compensation Service Bureau early in 1914) credit is due for the plan of bringing the insurance rates in all compensation states into harmony through a proper system of differentials instead of trying to prepare an independent schedule of rates in each state on the basis of its own experience.

Systems of state differentials were not altogether new in casualty insurance. They had been in use for a time in connection with employer's liability insurance. But while the old system of state differentials was largely a result of underwriting judgment (as to the comparative stringency of liability laws and as to the general conditions in various states) Professor Whitney's plan presupposed a scientifically accurate objective method of computation.

For the purpose of devising such a method a committee of casualty insurance experts was appointed by Professor Whitney.*

It was agreed that the method of computing costs of a given number of accidents, as advocated by the writer, promised the most satisfactory results. Instead of trying to depend upon the unsatisfactory accident statistics of any one of the American states or foreign countries, it was decided to establish one definite standard schedule of distribution of accidents according to gravity of the result, or in other words, to construct something akin to the standard mortality table in life insurance. This first step necessary for the computation of differentials was entrusted to the writer. The study which follows was prepared in response to this demand. As far as the writer is aware, it is the first effort of its kind ever made in

*This committee consisted of Mr. B. D. Flynn, Assistant Secretary of the Traveler's Insurance Company of Hartford, Conn., Mr. Stanley L. Otis, Actuary of the Workmen's Compensation Service Bureau, Mr. C. E. Scattergood, Assistant Secretary of the Fidelity & Casualty Company, and the writer for the Ocean Accident & Guarantee Corporation.

the domain of accident statistics or compensation insur
It has been adopted by the committee mentioned above, w
work received the unanimous approval of the Workr
Compensation Service Bureau, and it lies at the foundati
almost all compensation insurance rates at present in for
this country.

Definition of an Accident.

In endeavoring to use European statistics and especial
compare the data of one country with those of another
first serious difficulty is that arising out of the differenc
regard to the definition of what constitutes an industrial
dent. Reports on accident statistics have been str
influenced by the provisions of compensation laws. In
there were scarcely any satisfactory accident statistics in
country previous to the enactment of compensation
There are, however, many differences between compens
acts as to the kind of accidents covered by their provis
Several acts leave the care of minor accidents to other co-
ing institutions, especially where a well organized syste
sickness insurance is found. Thus, to quote the best k
illustrations, in Germany all accidents for the first thi
weeks, and in Austria those for the first four weeks, ar
to the care of sick benefit funds. Naturally, only those
dents come under the compensation system which resu
losses extended beyond this minimum period. In other
tries injuries lasting less than a certain minimum leng
time are left uncompensated altogether. In most case
published accident statistics disregard accidents which d
extend beyond this so-called waiting period. Thus, Ge
accident statistics cover only accidents leading to death,
manent disability, and temporary disability of over thi
weeks. In Austrian statistics, accidents leading to temp
disability under four weeks are excluded; in Italy, those u
five days; in Russia, those under four days; in France, u
three days, etc. Evidently, since the number of such m
accidents is very large, the percentage of all classes of se
accidents whether resulting in death or permanent disab
etc., will depend very much upon how many of those

are included, or in other words, will depend entirely accepted definition of an industrial accident.

ifficulty does not necessarily make European data ut it requires an adjustment before comparisons are that before the figures of any country are to be used, nts which do not come under the uniform classifica- t be eliminated, and on the other hand, for such as Germany and Austria where the definition of an s very narrow, the figures must be adjusted by means actor to compute the probable number of accidents uniform definition.

fter such adjustments are made does the principle that the distribution of accidents according to grav- nsequences is fairly uniform in all countries. This is rated by the following example showing the compara- oution of 42,063 accidents treated by the Leipzig sick 154,926 accidents occurring in Russia for the three- d, 1904 to 1906:

...es of Accidents.	Germany.		Russia.	
	Number.	Per Cent.	Number.	Per Cent.
...	32,235	76 16	113,353	73 13
...	7,618	18 58	32,896	21 28
	1,968	4 68	7,596	4 90
...	242	58	1,081	69
...	42,063	100	154,926	100

arison of the figures in the above table seems to certain substantial difference between the distribu- idents in the two countries compared. As a matter e difference is that in the German sick funds a good or cases have been reported which have been elimi- n the Russian statistics because of their duration er four days. This reduces the total number of but increases the percentage for the classes over four r thirteen weeks, and fatal, at the same time reduc- rcentage of accidents under four weeks. These fig- ere computed on a basis of one fatal accident. We lowing series expressed in multiples of the number of ents:

	Leipzig.	Russia
Fatal accidents	1	1
Over 13 weeks	8	7
Over 4 and under 13 weeks	31	30
Under 4 weeks	133	105

This clearly indicates the remarkable similarity betwee
statistics of the two countries except for the group of acci
of under four weeks' duration, where the material diffe
is explained by the considerations stated above.

The definition decided upon is identical with that acc
by the Statistical Committee of the Workmen's Compens
Service Bureau for the study of accident statistics of the
alty companies; namely, only such accidents are to be cou
and studied which disable the injured employee for any
other than the day of injury. The same definition
accepted by several conferences of officials of bureaus of
and by the American Association for Labor Legislation
promises to become the standard definition of an indu
accident in the United States. It is practically equivale
excluding accidents leading to disability of less than one
because the injured person who does not return to work i
beginning of the day after the injury, is not likely to r
at any time during that day.

This definition of an industrial accident is very
broader than that used in most governmental studies of
dent statistics. However, a precedent may be found i
statistics of accidents to employees of the United States
ernment recently published.*

There are practical reasons for selecting this defin
Even under liability insurance conditions, casualty comp
were insistent that the minor injuries be carefully rep
because the most trivial injury occasionally developed i
substantial claim or suit. The accident reports, or "not
as they are technically designated, have been much
numerous than accidents of sufficient gravity. A na
definition of "accident" would have entirely destroyed
basis of underwriting experience.

* See *Compensation for Injuries to Employees of the United States Arising from Accidents O* *between August 1, 1908, and June 30, 1911*, published by the Department of Commerce and Washington, 1913.

Certain difficulties are created by this definition because e is very little statistical material available to indicate the ber of these minor accidents, and adjustments of almost ata become necessary. For the purpose of such adjust-, use was made of the statistics of injuries to United es employees, as explained below.

FIVE GROUPS OF ACCIDENTS.

ving accepted the standard definition, the problem is to ain the following relations:

t—The relative number of fatal accidents.

nd—The relative number of permanent total disability

d—The relative number of dismemberments and their er

th—The relative number of permanent partial dis-cases and their distribution by degree of disability.

—The relative number of temporary disability cases distribution of such cases according to duration.

it would be quite practicable to deal in percentages ng the figures to any necessary degree of accuracy, it preferable to assume a standard total sufficiently large it of all necessary sub-divisions and yet not so large ppear quite fanciful. The number of 100,000 was upon since in many of the larger states that many al accidents will occur in a year or two. The advan-such a large base is that in the computations individual e dealt with and not fractions of cases.

above division into five groups is necessitated partly nature of the problem and partly by the peculiarities merican compensation acts. There is a very fine line arcation between permanent partial disability and ent total disability, but an independent determination tter cases becomes necessary because special provisions n are made in most American acts. Still more impor-the treatment of cases of dismemberment by specific in American acts, instead of considering the propor-earning capacity lost, which is the European method. e five sub-divisions, some are due to definite physical

facts, so to speak, and not dependent upon differences in i pretation of the law. This includes fatal accidents, the ber and character of dismemberments, and perhaps the tribution of temporary disability cases according to dura On the other hand, when we deal with cases of perma partial disability, and especially their distribution by d of disability, we are dealing with facts which are largely enced by differences in interpretation of law, and here largest variation between one country and the other ma expected. In utilizing the statistics of foreign countrie the purpose of computing each one of these five grou accidents, different checks and tests must therefore be i duced.

Fatal Accidents.

The experience of Massachusetts for the first year o application of the Compensation act, as reported by Industrial Accident Board, gives 474 fatal accidents out c total of 90,168, or some 525 per 100,000. The Massachu report has no definition of accidents but counts all acc notices received. The following figures indicate the in tance of adjusting the accident definition for the purpo obtaining the percentage of fatal injuries:

Percentage of Fatal Accidents in Various Count

Massachusetts (1912–1913)—0.5 per cent. of all notic

Leipzig Fund (1887–1903)—0.6 per cent. of acciden over three days' duration.

Russia (1900–1906)—0.7 per cent. of accidents of over days' duration.

Italy (1902)—0.75 per cent. of accidents of over five duration.

Austria (1897–1901)—4.1 per cent. of accidents of four weeks' duration.

Germany (1899–1908)—8.4 per cent. of accidents of thirteeen weeks' duration.

In not a single instance do we find a definition of "accid which would correspond to the one adopted here. To the Massachusetts data conform to this definition, it is n sary to eliminate from the 90,168 notices those accidents w

n of disability did not last over one day. Their num-
ot stated in the report, but it is indicated in a diagram
41 per cent. of all non-fatal accidents the disability did
over one day:

68 − 474 fatal accidents = 89,694 non-fatal accidents.
94 × .41 = 36,774 accidents of not over one day's
ion.

ng these, the total number of accidents in Massachu-
1912–1913 is reduced from 90,168 to 53,394, and the
al accidents constitute 0.888 per cent., or 888 per
accidents.

e these figures are accepted, comparisons with a few
untries are necessary. In Austria from 1897 to 1901
ere 3,871 fatal accidents out of a total of 95,269 acci-
over four weeks' duration. To adjust this to our
l American definition of an "accident" the following
may be used:

ding to the report on accidents among United States
es for 1908 to 1911, the 20,835 accidents were dis-
as follows:

Duration	Number.	Per Cent.
1 to 7 days	7,482	35.9
7 to 14 days	3,753	17.0
15 to 28 days	4,238	20.3
All other	5,362	25.8
Total	20,835	100.0

ents of over four weeks' duration constitute 25.8 per
ll accidents of over one day's duration, we may assume
95,269 accidents of over four weeks' duration in
correspond to 95,269 ÷ 25.8 per cent. = 369,260 acci-
over one day's duration, on which basis Austria shows
al accidents per 100,000.

period of ten years the German industrial accident
ons reported 54,166 fatal accidents out of a total of
accidents of thirteen weeks' duration, the fatalities
ing 8.43 per cent. Again, the United States statis-
ort referred to above indicates that accidents of over

thirteen weeks' duration constitute only 8.89 per cent. o accidents of over one day's duration. The number of accid of over one day's duration in Germany for the ten years w be equal to 642,344÷8.89 per cent. = 7,225,460, and the n ber of fatal accidents per 100,000 would be 750. In Ita report for 1902 shows 430 fatal accidents out of a total of 57 accidents of over five days' duration, or 746 per 100,000. Russia for a period of three years there were 2,345 fatal dents out of 299,874 accidents of over four days' duratio 782 per 100,000. In both these latter cases the true ave would be somewhat smaller if all the petty accidents had included. The United States report shows 670 fatal accid out of a total of 20,835, or 3,216 per 100,000, which is evide too high a figure explained by the very hazardous nature o occupations covered by the Act of 1908. Averaging the accident frequency in only four countries, Austria, Germ Italy, and Russia, where a fairly general distribution of in tries and occupations obtains, the average is 837 per 100 which is not very far from the Massachusetts figure of In accepting the latter figure, it must be remembered that Massachusetts report was prepared very soon after the pletion of the year. Experience in Germany has demonstr that within four or five years the number of fatal accid increases by about 5 per cent. because of the subsequent d of many injured persons whose injuries originally did appear to be fatal. Loading, therefore, the accepted figur 5 per cent., we arrive at 932 fatal accidents per hundred t sand injured.

Dismemberments.

Because most American acts contain specific schedule benefits for cases of dismemberment, it is necessary to m an estimate of their number as well as the distribution an different kinds of dismemberments. As these cases are treated in that fashion under the European compensation comparatively little information is available. The best is contained in the Austrian report for 1897 to 1901, which is only source for exact data as to distribution of as large a n ber as 8,686 cases of dismemberment according to the e nature of the loss sustained in each case.

e test is necessary to establish how far the proportion of aberments differs, if at all, from such American expe-as we have. The Massachusetts report shows 967 dis-rments out of a total of 90,162 accidents. To make mparable with the Austrian figures, all accidents of four weeks' duration must be eliminated, leaving only accidents of over four weeks' duration. Dismember-onstitute 8.6 per cent. of that number. Of the Austrian ases, 109 resulted fatally, leaving 8,577 cases, which in ion to the 95,269 accidents of over four weeks' dura-9 per cent. As Austrian figures are more complete a certain number of cases must lead to amputation me after the original injury has been sustained, it is the Austrian and Massachusetts figures on that point ciently comparable to permit the use of the Austrian The experience from Michigan as reported in the *l Compensation Journal* of June, 1914, for six months, er 1, 1914, to May 31, 1914, gives 318 dismemberments 6 cases of temporary disability, giving a proportion of per cent. But the Michigan report includes all acci-over two weeks' duration. As the number of accidents two to four weeks' duration is approximately equal to ber of accidents of over four weeks' duration, it would that cases of dismemberment in Michigan amount to per cent. of all the accidents of over four weeks' dura-ich is even higher than the Austrian figures. There-the whole, the Austrian figures may be accepted. In wing statement is given a classified list of dismember-ccurring in Austria within the period specified, and number per 100,000 on a basis of all accidents of one ration or over, for which purpose the 95,269 accidents our weeks' duration were assumed to represent 369,260 according to our accepted definition.

Kind of dismemberment.	Number of cases in Austria, and whether resulting in permanent disability or not, but exclusive of cases resulting fatally.	Number per hundred thousands on an assumption of 300,300 cases.
1. Loss of left arm	230	65
2. Loss of right arm	352	96
3. Loss of left hand	183	50
4. Loss of right hand	225	61
Loss of [illegible]		
5. Loss of left thumb	106	29
6. Loss of right thumb	114	31
7. Loss of left index	219	59
8. Loss of right index	255	69
9. Loss of left middle finger	96	26
10. Loss of right middle finger	116	31
11. Loss of left ring finger	51	14
12. Loss of right ring finger	63	17
13. Loss of left little finger	118	32
14. Loss of right little finger	127	34
15. Loss of thumb and [illegible], left hand	51	14
16. Loss of thumb and [illegible], right hand	62	17
17. Loss of two or more fingers [illegible]	232	63
18. Loss of two or more fingers [illegible]	245	66
Loss of one phalange [illegible]		
19. Loss of left thumb	[illegible]	55
20. Loss of right thumb	228	62
21. Loss of left index	[illegible]	83
22. Loss of right index	343	93
23. Loss of left middle finger	[illegible]	52
24. Loss of right middle finger	[illegible]	53
25. Loss of left ring finger	[illegible]	25
26. Loss of right ring finger	[illegible]	19
27. Loss of left little finger	[illegible]	18
28. Loss of right little finger	[illegible]	17
29. Loss of fingers [illegible] the same hand, left	[illegible]	172
30. Loss of fingers [illegible] the same hand, right	[illegible]	173
31. Loss of one leg	[illegible]	129
32. Loss of both legs	[illegible]	3
33. Loss of toes	[illegible]	57
34. Loss of one eye	[illegible]	465
35. Loss of one eye with [illegible] the other	[illegible]	62
36. Loss of both eyes	[illegible]	14
Total dismemberments	[illegible]	2,[illegible]

PERMANENT [illegible]

Specific provisions for [illegible] in cases of permanent total disability are found in many [illegible] acts differing materially from provisions [illegible] disability. In many states life pensions [illegible] permanent total cases where only [illegible] are given for permanent partial [illegible] of this nature are few, the cost must be a [illegible] compared with the total cost of compensation [illegible] estimate as to the probable number of [illegible] necessary.

Here foreign material must be used with extreme care because it is a condition largely depending upon the interpretation given to the term. In some cases there can be no difference of opinion as to the existence of permanent total disability. In others, however, it will largely depend upon the liberality with which compensation acts are administered. No American data on the subject exist, and the European data show considerable fluctuations. The percentage of cases of permanent total disability in official reports fluctuate between .06 per cent. in Italy and 1.51 per cent. in Austria. To a large extent this difference, as already explained, is due to the differences in the definition of the word "accident," and the number of minor accidents excluded. To obtain a basis of comparison without the necessity of adjusting all figures to one uniform basis of an accident of over one day's duration, we have assumed as a measure the proportion of cases of total permanent disability to 100 fatal accidents with the following results:

NUMBER OF CASES OF PERMANENT TOTAL DISABILITY PER 100 FATAL ACCIDENTS.

Austria	28.5
Germany	14.7
Russia	12.8
France	8.4
Italy	7.5

These differences are not to be explained by physical conditions only. We find that the Austrian interpretation of the definition of permanent total disability is the most liberal of all and almost twice as liberal even as that of Germany. Averaging the proportions in the five countries, we obtain 14.38 cases of permanent total disability per 100 fatal accidents, which is about one half of the proportion in Austria alone.

However, in view of the excessive ratio shown in Austria as compared with other countries, the average for the five seems to be preferable, and this indicates 14.4 cases of permanent total disability per 100 fatal accidents. On an assumption of 932 fatalities per 100,000 accidents, we get 133 cases of permanent total disability. As against this figure we have already included 14 cases of loss of both eyes and 3 cases of loss of both

legs in the dismemberment schedule. We have also ass
62 cases of loss of one eye with injury to the other, 10 per
of which, or 6 cases, constitute permanent total disabilit
cording to the Austrian experience, so that 23 cases of p
nent total disability are already included in the dismember
schedule, and cases of permanent total disability not dis
berments are therefore reduced to 110.

PERMANENT DISABILITY OTHER THAN DISMEMBERME

This group of injuries presents perhaps the greatest diffi
in the effort to construct our standard accident table.
manent reduction in the earning capacity of the injured
man, which does not necessarily destroy his economic
fulness entirely, but puts him down in the economic
frequently follows the class of injuries described abov
dismemberment. It is evident that a man with one a
worth less in the labor market than he was while both
were intact. But permanent partial disability is not
limited to such self-evident cases. Unhealed fractures,
reduced dislocations resulting in loose joints, stiff joints, p
paralysis, ruptures, and many similar cases may hav
same economic effect as loss of part of body. Because
memberments have been made subjects of special regul
in most acts, it becomes necessary to separate those from
cases of permanent partial disability. Unfortunately,
good many American acts, and still more in the administr
of compensation laws in a good many American states,
condition of permanent partial disability due to other c
than dismemberment is not yet always sufficiently
recognized.*

Perhaps for this reason it is useless to expect any acc
reports of such cases in the early statistics of compensati

*An interesting illustration of this may be found in the report of the Michigan Industrial Accide
as to accidents occurring between December 1, 1913, and May 31, 1914, as published in the
Compensation Journal for June, 1914. The first table of this report is entitled. "Accidents ca
manent partial disability classified by part of body affected," and in this table are listed 318
every one of which is a case of dismemberment. It seems that the Michigan Industrial Board w
lutely unaware of the existence of these cases of permanent partial disability which are not du
memberment, and yet it is quite evident that a large number of such cases must have occurred.
are not self-evident at the time the accident has happened. In a great many of such cases a lo
may elapse before the permanent nature will be realized.

this country, but it must not be assumed that because American statistics have not recorded such cases, they do not occur in actual practice. Undoubtedly, they have been handled in each state as cases of temporary disability until the permanent character has been established. Undoubtedly, also, in a good many cases the reduction in earning capacity if not excessive has been and is being disregarded. It is known, however, that there have been such cases in the state of Massachusetts. The first report of the Industrial Accident Board indicates on page 324 that there have been 1,457 cases of permanent partial disability though the number of dismemberments as stated on page 19 is only 967, leaving 490 cases of permanent partial disability not dismemberments, or about 50 per cent. as many as dismemberments. Again, in the first report of the Industrial Accident Board of California covering the period from September 1, 1911, to December 31, 1912, we find an analysis of 9,627 accidents, of which 412 were fatal and 534 resulted in permanent disability, and of the latter only 79 cases or about 15 per cent. are cases of permanent injury not due to dismemberment. In the state of Washington for the first year of operation of the act there have been 685 cases of permanent disability against 279 fatal accidents, the proportion being so high that it was quite probable that a large number of cases not dismemberments have been included.

But while their existence is being recognized, comparatively few of them are as yet recorded. It is necessary, therefore, to turn to European data to get a better conception of their importance and value. As already indicated, a comparison of statistics of various countries is somewhat vitiated by the differences in the definition of an accident, and since the reduction of all the statistical data to one basis of accidents of one day's duration is a rather difficult undertaking, the method of comparing them with the fatal accidents offers a more convenient shortcut.

The following table shows a degree of variation in this proportion among various European countries:

PERMANENT DISABILITY CASES IN PROPORTION TO FATAL ACCIDEN

Countries.	Years.	Number of Fatal Accidents.	Number of Accidents Resulting in Permanent Disability.
Austria	1897–1906	8,349	82,446
Belgium	1905–1908	1,838	8,204
Denmark	1899–1906	389	4,192
France	1899–1908	18,708	140,877
Germany	1899–1908	50,393	313,219
Italy	1898–1902	2,224	9,701
Norway	1895–1905	832	4,496
Russia	1904–1906	2,345	34,961
		84,578	598,116

The ratio of permanent disability cases to fatal accidents s
to vary from 4.4 in Italy to 14.9 in Russia, the average
7.1. The ratio seems to be fairly uniform in four or five
tries such as Belgium, Italy, Germany, and Norway,
about 5 per cent., but rises to 10 per cent. or over in Au
Denmark, and Russia. The variations are evidently
nificant of differences in the matter of judgment and de
in regard to individual cases rather than of bare physical
For all of these countries except Austria all cases of perm
partial disability, including those resulting from dismem
ment, are stated together. Since the dismemberment
have already been treated in a different way, it is necessa
obtain information as to the number of other cases, and fo
Austria alone offers statistical data. Because of this
dental advantage of Austrian figures over all others, they
been used very largely by the New York State Insu
Department in its work of determining a differential bet
the cost of compensation under the New York and the M
chusetts compensation acts, and the use of these Aus
figures was very violently contested. The difficulty ca
be denied that Austrian statistics indicate twice as la
number of cases of permanent disability as most other
tries. A careful inspection of the Austrian tables as re-
lished in the twenty-fourth Annual Report of the Commiss
of Labor does raise serious doubts as to whether such liber
of interpretation may be expected in any of the states fo
first five or ten years, especially since it is twice as high

Germany. Even in Austria the proportion of such cases has been regularly increasing. Thus, in 1897 the proportion of permanent disability cases to fatal accidents was 8 to 1; in 1900, 9.8 to 1; and in 1906, 11.5 to 1.

We feel safe, therefore, in assuming that for the next few years at least, five cases of permanent partial disability against one fatal accident will be nearer the actual conditions than the proportion obtaining in Austria now. In other words, we may safely reduce the number of permanent partial cases as indicated by Austrian figures by 50 per cent.

In our table we have assumed 932 fatal accidents which would make the total number of permanent disability cases 4,660. The number of dismemberments we found to be 2,323 per 100,000. As a matter of fact, Austrian statistics indicate that out of a total of 8,579 cases of dismemberments 795, or 9.3 per cent., were so slight that even in Austria they were not considered as cases of permanent disability. Subtracting this 9.3 per cent. from the 2,323 cases, we have 2,108 cases of dismemberments per 100,000 leading to permanent partial disability. Subtracting this number from the total assumed number of permanent disability cases, we get 2,552 cases of permanent disability not due to dismemberments. Of these, as indicated earlier, 110 are cases of permanent total disability, leaving 2,442 cases of partial permanent disability not due to dismemberment.

Degree of Permanent Partial Disability.

The next question that requires investigation is the distribution of these cases according to degree of disability, upon which compensation depends. Here again we must draw entirely upon European data, and this again is a matter of judgment largely and everything depends upon the customary method of adjusting such cases. It is reasonable, therefore, to expect a very wide difference between results in different countries.

When an effort is made to compare information on this point as given in the reports of different countries, an additional difficulty arises from the fact that the sub-groupings in different countries are not uniform. Thus, for instance, in

German statistics the permanent disability cases are di into only four groups: Under 25 per cent. disability, be 25 per cent. and 50 per cent., between 50 per cent. and 7 cent., and between 75 per cent. and 100 per cent. I reports contain ten groups, one for each 10 per cent. c ability, while Austria has a division into seven groups entirely different basis. Finally, the third difficulty co in the fact that in all countries except Austria all cases o manent disability are lumped together whether due t memberment or not. It is reasonable to assume tha degree of disability due to dismemberment is often more s than that due to other causes. In view of the specific sions for dismemberments, it is necessary to eliminate from the cases of permanent disability, but the only co for which this is feasible is Austria.

In the following table is shown the distribution of all of permanent disability in Austria according to the deg disability. Similar data are given also for cases of dis berment as well as for all cases of permanent disability than dismemberment.

The first column indicates the rate of benefit in perce of wages, which is the method of classification used in Au sources. The second column states the degree of disa covered by the rate of benefit, the Austrian law granti per cent. of the loss of earning power.

The actual number of cases in 1891 to 1901 is sho column 3, and the percentage distribution in column computation of the average degree of disability is ma columns 5 and 6 on an assumption that the mean c two limits is the average degree of disability for each g The last column shows the results of this computation was to be expected, dismemberments lead to higher de of disability. This is well shown by the percentage colu well as by the average computed.

The average degree of disability for dismembermen 43.1, and for all other cases 29.1. But since there are nu cally a great many more cases of permanent disabili Austria not due to dismemberments, the average degr disability for all cases (32.1) is only slightly affected b higher degree of disability of the dismemberment cases.

AUSTRIA.

ALL CASES OF PERMANENT DISABILITY.

Rate of Benefit (Per Cent. of Wages).	Degree of Disability (Per Cent.).	Number of Cases.	Per Cent.	Average Degree of Disability.	Total Amount of Disability (Average Degree ×No. of Cases).	General Average.
5 or under	8 or under	3,629	9.8	4	14,516	
6–11	9–18	11,707	31.7	13	152,191	
12–19	19–32	7,126	19.4	25	178,150	
20–29	33–48	5,760	15.6	40	230,400	
30–39	49–65	3,487	9.4	50	195,272	
40–50	66–83	4,098	11.1	74	303,252	
60	100	1,104	3.0	100	110,400	
		36,911	100.0		1,184,181	32.1
DISMEMBERMENT.						
5 or under	8 or under	603	7.7	4	2,412	
6–11	9–18	1,323	17.0	13	17,199	
12–19	19–32	1,090	14.0	25	27,250	
20–29	33–48	1,789	23.0	40	71,560	
30–39	49–65	778	10.0	50	43,568	
40–50	66–83	1,722	22.1	74	127,428	
60	100	479	6.2	100	47,900	
		7,784	100.0		337,317	43.1
ALL OTHER.						
5 or under	8 or under	3,026	10.4	4	12,104	
6–11	9–18	10,384	35.7	13	134,992	
12–19	19–32	6,036	20.7	25	150,900	
20–29	33–48	3,971	13.6	40	158,840	
30–39	49–65	2,709	9.3	50	151,704	
40–50	66–83	2,376	8.2	74	175,824	
60	100	625	2.1	100	62,500	
		29,127	100.0		846,864	29.1

The fact that Austria shows four times as many cases of permanent disability other than dismemberments makes the use of Austrian data subject to criticism. The same liberality which leads in Austria to a recognition of permanent partial disability where such would be denied in other countries may also lead to adjustments in favor of higher degrees of disability than would be the case in other countries. Of course, since we are dealing here not with the number of cases of partial disability but only with their distribution according to degree, these two tendencies mentioned may actually counteract each other, that is, if on one hand the tendency to allow larger degrees of disability than would other countries, would disturb

the percentage series by making the higher groups he
than they should be, then, on the other hand the tenden
recognize light degrees of permanent partial disability, w
in other countries no permanent results would be clai
would have the opposite tendency of loading the lower g
of the percentage series. In any case, we think it is saf
check up the results of Austrian experience by that of
countries.

The following statements are given with similar com
tions for Denmark, Italy, and Germany:

DENMARK (1899–1906).

Degree of Disability (Per Cent.).	Number of Cases.	Per Cent.	Average Degree of Disability in Group.	Total Amount of Disability (Average Degree ×No. of Cases)	Average De Disability a (Per Cen
5	300	7 2	3	1,600	
6–10	1,400	33.4	8	10,400	
11–20	1,384	33 0	15	20,700	
21–25	265	6 4	23	5,995	
26–50	658	15 6	38	25,004	
51–100	185	4 4	70	12,950	
	4,192	100 0		[illegible]	18.3

ITALY (1902).

Degree of Disability (Per Cent.).	Number of Cases.	Per Cent.	Average Degree of Disability in Group.	Total Amount of Disability (Average Degree ×No. of Cases)	Average De Disability a (Per Cen
1–4	6	.22	2.5	15	
5–10	1,157	42 10	7 5	8,678	
11–20	576	20 96	15.5	8,928	
21–30	330	12 01	25 5	8,415	
31–40	318	11 57	35.5	11,289	
41–50	130	4 73	45 5	5,915	
51–60	63	2.29	55 5	3,497	
61–70	74	2.69	65.5	4,847	
71–80	62	2 26	75 5	4,681	
100	32	1 16	100 0	3,200	
	2,748	100.00		59,465	21 6

GERMANY (1896–1905).

Degree of Disability (Per Cent.).	Number of Cases.	Per Cent.	Average Degree of Disability in Group.	Total Amount of Disability (Average Degree ×No. of Cases)	Average De Disability a (Per Cen
25 or under	34 88	65 3	15	979.5	
25–50	12.17	22 8	35	798 0	
50–75	4 02	7 5	60	450 0	
75–90	1.18	2 2	85	187 0	
100	1.18	2 2	100	220 0	
	53.43	100 0		[illegible]	20.3

The average degree of disability in cases of permanent disability in the different countries appears to be as follows:

	Per Cent.
Denmark, all cases	18.3
Italy, all cases	21.6
Germany, all cases	26.3
Austria, dismemberments	43.1
Austria, not dismemberments	29.1
Austria, all cases	32.1

This difference, like the one in regard to the number of cases of permanent disability, is probably one of judgment rather than of physical facts, and the best method, therefore, appears to be to obtain an average of the data in the various countries so as to get a picture of the average conditions in Europe. Austria was found to be more liberal in determining the number of cases of permanent partial disability, and the same liberality appears in the matter of judgment of the degree of disability, but if Austria seems to be too liberal in these respects, it is probable that the decisions in Denmark, showing nearly 75 per cent. of such cases with less than a 20 per cent. degree of disability, are less liberal than they would be in this country. The tendency of decisions in regard to such cases in this country, where the question comes up at all, would be towards fairly liberal allowances. It is often argued that these results in Germany and in Austria have come only after a long period of experience with compensation, after the training of workmen in malingery, etc. As a matter of fact, the rule works also in an opposite direction. There has been in Germany recently a very strong tendency towards very much stricter decisions as to the degree of disability than in the beginning of the compensation experience. In the absence of any other basis for judgment, we feel that as far as the question of degree of disability is concerned, we are conservative in assuming that adjustments in this country will on the average be as favorable to the injured as they are in Europe.

It was, therefore, decided to average the data for Austria and Italy and Germany. The Danish series was discarded because of the small exposure and its rather unsatisfactory

arrangement. In averaging the other three countries the culty was met of groupings not uniformly arranged. To come this the following method was used:

For each country a diagram was drawn indicating the centage distribution within each given interval by an ar a rectangle, having that interval for a base. Then perpe ular lines were drawn at each ten per cent. and the area of ten per cent. group was computed. While this meth somewhat crude, it does introduce a substantial correctio gives results which appear fairly satisfactory. In the follo table the distribution of cases of permanent disability in three countries is shown, so adjusted as to give the dat groups ending with ten per cent.

DISTRIBUTION OF CASES OF PERMANENT PARTIAL DISABILITY BY DEGREE O ABILITY, AUSTRIA, ITALY, AND GERMANY.

Per Cent. of Disability.	Austria.			Italy (Per Cent. of Cases).	Ger (Per C Ca
	Dismemberment (Per Cent. of Cases).	All Other (Per Cent. of Cases).	All Cases (Per Cent. of Cases).		
0-10	11.1	17.5	16.1	42.3	1
11-20	15.6	31.5	26.0	20.9	2
21-30	10.0	14.8	13.9	12.0	1
31-40	13.5	9.8	10.6	11.6	
41-50	12.7	7.9	8.9	4.7	
51-60	5.9	6.5	5.5	2.8	
61-70	9.1	5.0	5.9	2.7	
71-80	12.3	4.6	6.2	2.8	
81-90	3.6	1.3	1.9	.....	
91-100	6.2	2.1	3.0	1.2	
	100.0	100.0	100.0	100.0	10

To obtain an average for these three countries only column was taken for Austria, namely, that giving the tribution for cases other than dismemberments. The ave obtained and the application of these percentages to cases are shown in the following table:

Degree of Disability.	Percentage of Cases.	Number of Cases per 100,000.
0–10	26.3	672
11–20	28.6	728
21–30	14.8	378
31–40	10.4	265
41–50	7.0	179
51–60	3.6	92
61–70	3.6	92
71–80	3.0	77
81–90	.9	23
91–100	1.8	46
		2,552

By an independent method we have already determined the cases of permanent total disability to equal 110 (exclusive of dismemberments). As a matter of fact there are very few (and in some countries no) judgments of degree of disability over 80 per cent. because when disability reaches that limit it is practically recognized as total disability on account of the impossibility of obtaining employment. Therefore, to avoid duplications we exclude all the cases of the last two sub-groups and also reduce group 70–80 by 41, leaving in that group only 36 cases so as to balance the figure up to 2,442 cases of permanent partial disability not due to dismemberment.

Temporary Disability.

To arrive at the number of these cases it is only necessary to subtract all cases already determined from 100,000 as follows:

Fatal accidents	932
Dismemberments	2,323
Permanent total disability not dismemberments	110
Permanent partial disability not dismemberments	2,442
Total serious accidents	5,807
Temporary disability only	94,193
Total	100,000

In connection with this class of injuries the importan
tion is that of duration of disability. In regard to th
largest volume of American experience is contained in th
report of the Massachusetts Industrial Accident Board,
89,694 accidents are distributed as follows:

Under 2 weeks	68,58
2–4 weeks	10,56
4–8 weeks	6,63
8–13 weeks	2,35
13–26 weeks	1,27
Over 26 weeks	27
Total	89,69

It would be preferable to use American data such as
quoted above, but unfortunately these figures are defici
several reasons. First, accident notices, irrespective of
tion, have been included which give an abnormally
number of cases under two weeks. Second, the sub-gro
are not sufficiently detailed. In utilizing these figures
computations of the New York differential, the New
State Insurance Department was forced to assume th
average duration in each group was the mean of the
three weeks for the group from two to four weeks, six we
the group from four to eight weeks, etc. As the num
cases in each group rapidly declines the average is pr
much nearer the lower limit than the mean, and whe
margin between the limits is so great a considerable e
introduced thereby. Third, the Massachusetts report
to divide all the cases into two groups, fatal and those o
porary disability. It is evident that the series quoted
contain all the cases which eventually lead to permane
ability. Even dismemberments are included in that
the duration meaning that of total disability irrespect
the subsequent partial disability. The result of this
make a very much higher percentage of accidents of
duration.

Fortunately a much better series of figures for this p
is available in the twenty-fourth Annual Report of the
States Commissioner of Labor, namely, the data in reg

accidents in Russia for a three-year period, 1904 to 1906, where the distribution is given by weekly periods up to thirteen weeks and where the temporary and the permanent cases are separately analyzed. The fact that these figures appertain to Russian conditions need not disqualify them in view of the general theory underlying the standard table.

There is one difficulty about this series: The accidents of under four days' duration are not reported. This makes the total of accidents seven days or under too small. This, however, can be corrected as explained presently. To determine whether the use of these Russian statistics is justifiable, they were subjected to a test to find out how far they are comparable with the Massachusetts figures on general lines. In order to make such a comparison possible, 41 per cent. of notices, relating to accidents of under one day's duration, were taken out of the Massachusetts series. These notices, amounting to 36,774, were deducted both from the total and from the number of accidents of under two weeks' duration, thus obtaining for Massachusetts the following corrected series:

Period of Disability.	Number.	Per Cent.
Less than 2 weeks	31,812	60.1
2-4 weeks	10,568	20.0
4-8 weeks	6,638	12.5
8-13 weeks	2,355	4.5
13-26 weeks	1,275	2.4
Over 26 weeks	272	.5
Total	52,920	100.0

Distributing 153,843 non-fatal accidents, occurring in Russia, 1904-1906, in the same large groups, we get the following results:

Period of Disability.	Number.	Per Cent.
Under 2 weeks	79,577	51.7
2-4 weeks	33,776	22.0
4-8 weeks	23,164	15.0
8-13 weeks	10,144	6.6
Over 13 weeks	7,182	4.7
Total	153,843	100.0

A comparison of these two series indicates a smaller percen of disability of under two weeks and a larger percentag accidents in all other groups in Russia as compared with Ma chusetts, but this evidently is due to the omission of accid resulting in disability of under four days' duration in Russian statistics. This has been corrected in the follo manner. The Massachusetts data indicate that there three times as many cases in the first group, from one da two weeks, as there are in the second, from two to four we That would make the number of accidents in the under weeks group in the Russian series 101,328 instead of 79,57 an increase of 21,751. This correction must also be mad the total, which increases from 153,843 to 175,596. this correction the similarity of the percentage distributio both series becomes very much greater, as is shown in the lowing comparison:

Period of Disability.	Russia Per Cent.	Massachus Per Cen
Under 2 weeks	57.6	60.1
2–4 weeks	19.3	20.0
4–8 weeks	13.2	12.5
8–13 weeks	5.8	4.5
Over 13 weeks	4.1	2.9
	100.0	100.0

A slight difference between the two series still remains cating longer periods of duration in Russian statistics. may be easily explained by the fact that some of the M chusetts information is premature because in a good n cases the period of disability was unterminated at the tim statistical data were collected. In further support of figures we may quote an experience of over 20,000 accid to United States Government employees, 1908–1911, indica the following distribution:

Period of Disability.	Per Cent.
Under 2 weeks	55.1
2–4 weeks	20.2
4–8 weeks	14.0
8–13 weeks	4.5
Over 13 weeks	5.1

these comparisons prove that the Russian statistical quite applicable to American experience and therefore sed here, further refinement becomes necessary. The quoted include both temporary and permanent the treatment of permanent cases, especially dis- ent, in many state laws differs. In several states, ce, it is specifically provided that the so-called specific rment benefits should be exclusive of all other bene- other states, on the contrary, both temporary total benefit and dismemberment benefit may be made in cases. It becomes necessary, therefore, to separate groups of accidents and to construct a separate series ution by duration for the temporary injuries and e temporary disability period of permanent injuries. evident that in serious dismemberments or other eading to permanent disability of a partial character, stage of total disability will on an average be longer than in cases which leave no permanent s already stated such a separation is possible by Russian statistics, which is an additional argument se here.

DISABILITY IN TEMPORARY DISABILITY CASES ONLY. RUSSIA (1904 1906).

	Number of Cases in Russia.	Per Cent.	Computed Number of Cases for the Standard Table.
	59,925*	39.5	37,113
	38,667	25.5	23,925
	19,551	13.2	12,433
	11,272	7.4	6,970
	7,167	4.7	4,427
	4,335	2.9	2,732
	2,812	1.8	1,695
	1,897	1.2	1,130
	1,483	1.0	912
	944	.6	565
	715	.5	471
	571	.4	377
	459	.3	283
	1,492	1.0	933
ys	346	.2	197
.....	151,835*	100.0	94,193

s were added to the group "1-7 days" and to the total, so as to adjust it to our standard column the numbers have been re-computed on a basis of a total of 94,193, as assumed ies.

The Russian classification does not go beyond 13 w
throwing all the cases over that period into one g
The number of such cases was 1,897, or in the standard
1,130. It was more convenient to distribute these 1,130
in the two groups, 13-26 weeks and over 26, in proporti
the similar distribution in Massachusetts (in percentag
81.2 and 18.8). The groups above are so narrow tha
average duration of an injury in each group can easil
assumed as the mean between the limits because thos
confined within one week. This, however, does not app
the last two groups. The Russian sources indicate not
the number of cases in the group, but also the total numb
the days of disability. The average duration of disabili
the last group over thirteen weeks was 137 days or 19.5 w
which is just the mean between 13 and 26, so that for all
tical purposes this figure may be accepted for the last
groups.

The Standard Table.

The above analysis completes the distribution of 10
accidents according to their results as far as disability is
cerned. The table may be given here as a whole:

STANDARD DISTRIBUTION OF ACCIDENTS TABLE.

Fatal cases		932	
Dismemberments		2,323	
1. Loss of left arm	64		
2. Loss of right arm	95		
3. Loss of left hand	50		
4. Loss of right hand	61		
5. Loss of left thumb	29		
6. Loss of right thumb	30		
7. Loss of left index	59		
8. Loss of right index	69		
9. Loss of left middle finger	26		
10. Loss of right middle finger	31		
11. Loss of left ring finger	14		
12. Loss of right ring finger	17		
13. Loss of left little finger	32		
14. Loss of right little finger	34		
15. Loss of thumb and one or more fingers, left hand	14		
16. Loss of thumb and one or more fingers, right hand	17		
17. Loss of two or more fingers, left hand	63		
18. Loss of two or more fingers, right hand	66		
19. Loss of one phalange of left thumb	55		
20. Loss of one phalange of right thumb	62		
21. Loss of phalange of left index	83		
22. Loss of phalange of left middle finger	52		
23. Loss of phalange of right index	93		
24. Loss of phalange of right middle finger	53		
25. Loss of phalange of ring finger, left hand	25		
26. Loss of phalange of ring finger, right hand	19		
27. Loss of phalange of left little finger	18		
28. Loss of phalange of right little finger	17		
29. Loss of fingers accompanied by injuries of other fingers, left hand	172		
30. Loss of fingers accompanied by injuries of other fingers, right hand	173		
31. Loss of one leg	129		
32. Loss of both legs	3		
33. Loss of toes	57		
34. Loss of one eye	465		
35. Loss of one eye with injury to the other	62		
36. Loss of both eyes	14		
Permanent total disability other than dismemberments		110	
Permanent partial disability other than dismemberments		2,442	
Leading to Disability of			
1-10 Per Cent	672		
11-20 " "	728		
21-30 " "	378		
31-40 " "	265		
41-50 " "	179		
51-60 " "	92		
61-70 " "	92		
71-80 " "	36		
Temporary disability		94,193	
Not over 1 week	37,113		
1- 2 weeks	23,925		
2- 3 "	12,433		
3- 4 "	6,970		
4- 5 "	4,427		
5- 6 "	2,732		
6- 7 "	1,695		
7- 8 "	1,130		
8- 9 "	942		
9-10 "	565		
10-11 "	471		
11-12 "	377		
12-13 "	283		
13-26 "	933		
Over 26 weeks	197		
Total			100,000

The claims made for this table must not be misunders
It cannot be assumed for a moment that any 100,000 acci
occurring in this country will comply absolutely in thei
tribution with the proportions indicated in the table.
doubtedly, accidental variations may occur, and, further
a certain essential difference between conditions in this co
and those assumed in the construction of the table may
tually develop when actual experience has been compiled.
claim is made, however, that the cost of any 100,000
will not vary greatly from the cost of the accident
tributed in the Standard Table, and another claim m
made for the table still more emphatically, that even i
actual cost of 100,000 accidents may differ, the ta
sufficiently accurate for the purpose for which it was
structed, namely, to enable us to measure the differ
between compensation acts, because it is, after all, no
absolute cost but only the comparison of costs that w
trying to arrive at. In that respect some similarity m
indicated between this standard accident table and mor
tables. Not even the largest life insurance company
expect the actual deaths to comply absolutely with the m
ity table even if the latter were ideally correct. When
puted by independent age groups, the profits and losses i
various groups will probably fluctuate from year to yea
all of these fluctuations do not interfere with the reliabil
the mortality table as a whole. The vast amount of e
ence in compensation insurance which will undoubtedl
cumulate in this country within a very few years, will e
us to reconstruct this table, but the method of its applic
will not be changed thereby.

TEMPORARY TOTAL DISABILITY IN PERMANENT CAS

While the entire distribution of 100,000 accidents has
accomplished, there are several additional factors which
be taken into consideration and must be studied statisti
The first is the determination of the periods of total disa
which accompany cases of dismemberment and of perm
partial disability not dismemberment. For reasons indi
above, this must be computed separately because this

tional liability is not recognized in all compensation acts. The standard distribution according to duration as given above will not apply because the average nature of these injuries is very much more severe and the period of recovery longer. The Russian figures are the only ones which furnish information on this point. In the following table the 2,442 cases of permanent partial disability and the 2,323 cases of dismemberments are distributed according to the duration of total temporary disability applying to both groups the same percentage distribution ascertained from Russian statistics. The two groups of accidents are distributed here separately, because in some states dismemberments are excluded and then only the column for permanent partial disability must be used, while in others the total column may be applied.

Period of Disability.	Per Cent.	Number of cases.		
		Permanent Partial Disability.	Dismemberment.	Total.
Under 1 week	5.7	139	132	271
1-2	5.6	137	130	267
2-3	5.9	144	137	281
3-4	6.5	159	152	311
4-5	7.8	190	181	371
5-6	7.5	183	174	357
6-7	7.0	171	163	334
7-8	6.6	161	153	314
8-9	6.9	168	160	328
9-10	5.2	127	121	248
10-11	4.7	115	109	224
11-12	4.3	105	100	205
12-13	4.0	98	93	191
13 and over	22.3	545	518	1,063
	100.0	2,442	2,323	4,765

Dependency in Fatal Accident Cases.

The number of fatal accidents per hundred thousand was determined in the standard series as 932, but the correct valuation of their cost requires a good deal of additional statistical information. In regard to the number and status of the dependents, the laws differ very much. In some cases specific groups of dependents are provided for by definite proportions, and in such cases it becomes necessary to determine the number of such dependents who may be expected to survive. In

other states all dependents are given the same rights exc
to the distinction between total and partial depen
although in most cases certain relatives are designated a
dependents. As in all cases widows and orphans, u
certain age, are recognized as total dependents, th
important fact that must be ascertained is the conjug
tribution of victims of fatal accidents. In regard to thi
tion a very useful table is found in the report of the Wash
Industrial Accident Commission for 1912, where the co
condition of all injured employees is given, indicating
single and 3,005 married. No data are given for wid
divorced persons, and a letter of inquiry to the Comn
brought the reply that widowed persons without childre
classified with the single and widowed with children wi
married persons. The proportion, however, of single
the state of Washington appears unusually high, nea
per cent., and it may be explained by the character of p
tion and industry in a frontier state, but it will be
inapplicable to older settled communities.

In France for the period 1898–1905 insurance com
reported 9,055 fatal accidents* distributed according t
jugal condition as follows:

	Number.	Per Cent.
Single	3,057	33.8
Married	5,266	58.1
Widowed	578	6.4
Unknown	154	1.7
Total	9,055	100.0

French experience indicates, therefore, that little ov
third of the persons fatally injured are single. In Ger
there were 68 widows for each 100 fatal accidents repo
the Industrial Accident Associations, which is a son
higher ratio than in France, and may be easily explai
the comparatively higher marriage rate of Germany.

It seems safer for this country to assume the general p
tion of married and unmarried people among the male w

* Twenty-fourth Annual Report, United States Bureau of Labor, p. 704.
† *Ibid*., p. 1154.

population. The figures are taken only for the male population because the percentage of married persons is much higher for the female population, while the number of fatal accidents to women is extremely small and therefore can be disregarded.

Taking the entire male population of the country over 20 years of age, their distribution by conjugal condition is as follows:

Single	29.1 Per Cent.
Married	64.6 Per Cent.
Widowed	5.3 Per Cent.
Divorced	.6 Per Cent.
Unknown	.4 Per Cent.
Total	100.0 Per Cent.

The practical agreement of these United States Census figures with the results of special investigation of fatal accidents in France and Germany allows us to assume this as a basis for our standard table. For purposes of simplicity the unknown are thrown in with the single persons, and the divorced with the widows, so that the assumption is as follows:

Single persons	29.5 Per Cent.
Married persons	64.6 Per Cent.
Widowed persons	5.9 Per Cent.

which on the basis of 932 fatal accidents gives the following results:

Single persons	275
Married persons	602
Widowed persons	55
Total, fatal accidents	932

In a large number of states, as for instance Massachusetts, Kansas, Rhode Island, Nebraska, and others, the only point at issue in granting benefits for fatal accidents is that of existence of dependents, either total or partial, without any specific benefits being prescribed for specific classes of dependents. In such cases the assumption is justified that in all cases where victims of accidents were married there are total dependents, and as far as the widowers are concerned, while there may be

a few cases where no orphans survive, yet they would
exception, and in absence of definite information
assumed that for the widowed as well as married total d
ents existed in every case, which gives 657 cases wit
dependency. In addition to that there must be a certai
ber of the single fatally injured who leave dependents,
total or partial.

For the distribution of the total accidents to single
in regard to existence of dependency, some French dat
been used. They indicate that out of 3,057 single
fatally injured in France, 2,179, or 71.39 per cent.,
dependents under the French act. The statistics of d
ency in the state of Washington have already been refe
It was pointed out that the proportion between sin
married persons in the state of Washington would be
tional from that characteristic of other states. The
regard to the number of dependents for each one of t
groups need not be disqualified from use. As reference
table will show, out of 3,351 single employees injured, 2
73.3 per cent., have no dependents at all.

The higher percentage in the state of Washington ma
be explained by the larger proportion of young men
any relatives in the state, due to the transitory condi
the population, but the difference between the Was
and the French proportion is so slight that evidently
dealing here with a fairly uniform relationship. We
therefore, assumed that some 71 per cent. of the single
fatally injured leave no dependents at all, or 195 cases
the 275 fatal accidents to unmarried employees, or 93
accidents.

The final question requiring an answer is that of distr
of the remaining 80 cases according to the number leavi
dependents and that leaving partial dependents or
proved impossible to obtain any statistics on this point
Washington figures used here do not show it. The Ma
setts report for the year 1912–13 shows the existence
partial dependents for the 470 fatal accidents, but it d
indicate the number of cases to which these 103 partial d
ents belong, nor in how many cases these partial depe

were the only dependents. The Washington figures indicate that in the case of single persons fatally injured who leave any dependents at all, the average number of dependents is nearly 2, which would indicate that there were in the state of Massachusetts about 50 cases of partial dependency. However, there is no evidence that the partial dependents recorded were the only dependents in the respective cases. In recognizing the economic motive which would influence people to claim total dependency in all possible cases and the difficulty which must frequently arise in disproving such claims, we have assumed somewhat arbitrarily that in about 60 per cent. of the cases of fatal injuries to single employees leaving any dependents at all, the dependency would be recognized as total, and in 40 per cent. only partial dependence would exist, which makes the total number of cases with total dependents 48, and the number of cases with partial dependents 32. The final result of this analysis, therefore, is an assumption that the 932 cases will be divided according to dependency as follows:

Total dependents		705
Married	602	
Widowed	55	
Single	48	
Partial dependents		32
No dependents		195
Total		932

Number of Dependents.

In a few of the states having compensation acts at present the provisions for fatal accidents are somewhat more complicated. Specific benefits may be granted either according to the number of dependents surviving, or with an even greater effort at economic justice, according to the class or rather degree of relationship and number of dependents surviving. This is particularly true of the states of New Jersey, Minnesota, and New York, and similar provisions may be expected to become more numerous in the future. Therefore, it became necessary to obtain some data concerning the number of dependents surviving. Moreover, it is not always sufficient

to know the total number of dependents surviving
entire number of fatal accidents, but rather the distr
of cases according to the number surviving in each pa
case. Unfortunately, our Census statistics on the
families are not in such condition as to make the data av
for our purposes. The best information that is as yet av
has been collected by the Washington Industrial A
Commission in its report for 1912, giving the distributio
persons injured whether fatally or not according to cl
number of dependents.

DEPENDENTS OF EMPLOYEES INJURED IN THE STATE OF WASHINGTO

Single Persons.	Number of Cases.	Number of Dependents.
1. Single and no dependents	2,457	—
2. " " 1 "	440	440
3. " " 2 "	338	676
4. " " 3 "	49	147
5. " " 4 "	32	128
6. " " 5 "	13	65
7. " " more than 5 dependents	22	132
	3,351	1,588

Married Persons.	Number of Cases.	Number of Dependents.
1. Married and no children	800	800
2. " " 1 "	628	1,256
3. " " 2 "	556	1,668
4. " " 3 "	356	1,424
5. " " 4 "	196	980
6. " " 5 "	111	666
7. " " 6 "	43	301
8. " " 7 "	14	112
9. " " 8 "	3	27
10. " " 9 "	1	10
11. " no children, 1 other dependent	83	166
12. " " 2 " dependents	19	57
13. " " 3 " "	9	36
14. " " 4 " "	1	5
15. " " more than 4 dependents	1	6
16. " 1 child, 1 other dependent	53	159
17. " 2 children, 1 other dependent	35	140
18. " 3 " 1 " "	26	130
19. " 4 " 1 " "	16	96
20. " 5 " 1 " "	4	28
21. " more than 5 children, 1 dependent	5	40
22. " 1 child, 2 dependents	13	52
23. " 2 children, 2 dependents	12	60
24. " 3 " 2 "	2	12
25. " 4 " 2 "	3	21
26. " 5 " 2 "	5	40
27. " more than 5 children, 2 dependents	1	8
28. " 1 child, 3 dependents	5	25
29. " 1 " 4 "	3	18
30. " 2 children, 4 dependents	1	7
	3,005	8,250

This table shows that in the 3,005 cases of married persons injured, there were altogether 8,350 dependents. Presumably there were 3,005 consorts and of the remaining 5,345 dependents, 4,947 were children and 398 other dependents, largely parents. The Washington law recognizes dependency of children up to the age of 16 only; presumably only children of that age were included in the table, showing 164.6 children under 16 per 100 parents.

This data must be subjected to some sort of a check to ascertain how far the Washington data are at all applicable to conditions throughout the country. The United Census States for 1910 indicates that there were in that year 31,320,334 children under 16, and that the number of males married, widowed, and divorced was 19,720,152, giving a proportion of 177 children under 16 per hundred married males. The excess of this average over that in the state of Washington may be easily explained by the fact that a certain number of children under 16 have no father living. The proportion, therefore, of 164.6 children per 100 fathers may be accepted as essentially correct. Where the law grants rights to children up to the age of 18, the number of surviving children will naturally be larger. Based upon the figures of the United States Census, the estimate is made that the number of children under 18 per 100 parents should be increased to 184.4.

Utilizing these averages for the definite number of fatal injuries assumed in our standard table, we have as follows:

	Number of Cases.	Number of Dependents.
Widows, in accidents to married employees	602	602
Orphans, in accidents to married or widowed employees	657	1,071
Other dependents, in accidents to married employees	657	87
Other dependents, in accidents to single employees	80	144
All cases, with dependents	737*	1,904

This indicates 258 dependents per 100 fatal accidents leaving dependents, or 205 per 100 fatal accidents. If, however, dependent children up to the age of 18 instead of 16 be taken into consideration, the number of dependent children will

*This total does not represent the addition of cases in the column because in the latter the cases were entered more than once.

increase to 1,210, and the total number of dependents to 2,044, or 277 per 100 fatal accidents leaving dependents, or 219 per 100 fatal accidents occurring, which shows a remarkably close approximation to the German figures of dependents surviving, though computed independently on a basis of Washington figures and certain United States Census data.

In a careful valuation of fatal accidents further information may be necessary in regard to the relationship of dependents other than widowed and children. While information on this subject is very limited, nevertheless some use may be made of the Washington figures. We find that in 3,005 cases of injuries, there were 8,350 dependents of whom presumably 3,005 were widows and 4,947 were children, leaving for other dependents 398. The number of cases in which such other dependents were ascertained is 297. Of these, 222 cases had only one dependent other than widow or children, 55 cases had two dependents other than wife or children, and only 20 cases had more than two dependents of this class, the total number of such dependents in the 20 cases being 71. The number of dependents, therefore, in excess of two was only 31. The assumption seems justified that where only one dependent other than wife or children exists, that may be assumed to be either aged father or mother, and other dependents, largely brothers or sisters, were very few, only 31 cases out of 3,005, or about 1 case in a hundred fatal accidents. That proportion appears to be strikingly low, but it must be remembered that in most cases where specific benefits are given, the share assigned to the widow, orphans, or parent, will be sufficiently large to absorb the entire maximum amount of compensation allowable, so that in only a very few cases would brothers and sisters actually be in a position to claim compensation independently.

As far as the dependents of single persons are concerned, we have the Washington data indicating about 180 dependents per 100 cases leaving dependents. We have the indication from the French statistics that the proportion is only 133 per 100 cases, but the French act does not cover other dependents except parents. We may assume, therefore, that of the 180 dependents per 100 cases, 133 represent parents, and 47 other

dependents, largely brothers and sisters. Applying this proportion to the 180 cases of single employees in which dependents are expected according to our assumption, we may assume 106 parents and 38 brothers and sisters as dependents of single persons fatally injured. On the basis of such assumptions the cost of the 932 fatal accidents may be fairly accurately computed.

Age of Injured and Dependents.

In most states compensation to dependents is given for a temporary period only. In such states it may be assumed that in the majority of cases, and especially when the period is short, the full amount will be paid even if one of the dependents happens to die during the period of compensation, because other dependents would probably arise to claim the benefit. Even there exceptions must be made in a case of widows surviving without other dependents, because in such cases the death of the widow may cause the payments of benefits to be discontinued altogether. Actuarially, we are dealing here with the cost of a temporary annuity where the element of mortality plays an important part. Still more important is the element of mortality in a case of benefits to children, or all cases where life benefits are granted by the compensation act. Many acts grant life benefits in permanent total disability cases, and at least one is certain to grant life pensions in all grave injuries (California), while in several other states (New York, Ohio, Kentucky, and Maryland) there is a possibility that life pensions may be granted under the law in all permanent partial injury cases. It is evident, therefore, that the question of age both of the injured persons and the dependents acquires an important value in computing cost of compensation. Various statistical sources must be utilized to obtain some information on this subject. The Massachusetts Industrial Accident Board's Report for 1912–13 states the ages of fatally injured persons, from which the following computation has been made:

AGES OF FATALLY INJURED.

	Number.	Average Age.	Ag
Under 16 years.	4	15	
16–21	18	18.5	
21–30	135	25	
30–40	113	35	
40–50	83	45	
50–60	66	55	
Over 60	55	65	
	474		

The average age at death in fatal accidents appears
about 39½ years in the state of Massachusetts. On the
hand, in Illinois, according to the 6th Report of the Bu
Labor Statistics entitled Industrial Accidents in Illin
1912, the ages of the fatally injured are given as follow
cating an average age of 35:

AGES OF FATALLY INJURED.

	Number.	Average age.	A
Under 20 years	5	16	
20–25	30	22.5	
25–30	30	27.5	
30–35	30	32.5	
35–40	23	37.5	
40–45	20	42.5	
45–50	13	47.5	
50–55	10	52.5	
55–60	8	57.5	
60 and over	4	65	
	173		

In the absence of more accurate information it seems
able to assume one average age for all states for fatal i
which is approximately 37. In handling permanent
disability cases, use was made of the information given
Austrian statistics, which indicates that the avera
increases with the degree of disability; or perhaps it wo
more accurate to state that the degree of disability is a
by the average age, so that while for temporary cases a
cases of very light degree of permanent disability, the a
age appeared to be 37, it rose to 39 where the degree
ability is over 50 per cent., and to 42 where the degree
ability was total, and computations were based upon
broad conclusions.

y important question is the age of the widow rather the person fatally injured. Unfortunately, in this there seems to be scarcely any information about the ve ages of consorts. The average age of the widows by the United States Census would evidently be of ntage, because what must be ascertained here is the age at which widowhood arises, while the Census deals lows whose widowhood has arisen at different periods. t was made to utilize the statistics of the United States for this purpose, and the method is indicated here perhaps the results should be utilized, if at all, with a al of caution.

following table taken from the Thirteenth Census for hown the distribution of married males and married ccording to age group. An average age for married d females has been computed on the assumption that age age for each group is equal to the mean of the that group.

	Married Males (000's omitted).			Married Females (000's omitted).		
	Number.	Average Age.	Aggregate.	Number.	Average Age.	Aggregate.
	52	17.5	910	512	16 5	8,978
. .	1,100	22.5	24,750	2,225	22 5	50,063
. .	2,353	27.5	64,708	2,823	27 5	77,633
	2,611	32 5	84,858	2,620	32 5	85,150
.	4,873	39.0	190,047	4,410	39 0	171,990
	3,659	49.0	179,291	2,904	49 0	142,296
. .	2,113	59 0	124,667	1,480	59 0	87,320
.	1,304	69 0	89,976	687	69 0	47,403
	18,065		759,207	17,662		670,833

verage age of married men appears to be 42, and the ge of married women 35. It cannot be assumed that pective ages apply to the persons fatally injured and ows, but it does seem to indicate that there is a cerionship between the average ages of married men and women. The possible errors are the inclusion of males or females whose wives (respectively husbands) ncluded in this table. That would hold true of mar- whose wives are abroad (particularly immigrants) umber must be perceptible. On the other hand, the

number of married women immigrants in this country w husbands are abroad is probably not very large. The reason for discarding this computation is the rather sta character of the results indicating a difference of seven between the age of a married man and woman, which is l than would naturally be expected. Of course, the tend to under-estimate age on the part of the married female be taken into consideration.

Ages of Surviving Children.

Where benefits are granted to surviving children up certain age, whether 16 or 18, their ages are a matter of in tance. There is no reason to assume that the distrib according to age of the children surviving persons fa injured would on the whole be any different from a ge distribution by age of children under 18 or 16 years in country. For this purpose the statistics of the United S Census may be utilized. When this was done, it appeared the distribution among different ages beginning with un year and up to 17 years was fairly uniform. There slight excess of children of lower ages but this was com tively small. Thus, for instance, the number of children 6 years of age constituted 36.3 per cent. instead of 33. cent. It is therefore safe to assume the mean to represe average age fairly accurately. In other words, if the law vides compensation up to the age of 16, it is fair to assu as the average age, and if the law extends the compensati to 18 years of age, the assumption should be of an averag of 9. That slightly over-estimates age. On a more c computation, it would probably prove to be lower than On the other hand, because of the factor of compound int the value of a temporary annuity lasting until the age of computed at the age of 9, would probably be larger tha average value of annuities up to 18 years of age comput children of ages from 1 to 17, so that those two factors c eract each other, and for the purpose of simplicity the may be accepted.

In certain states this formula will not apply without fications. Thus, for instance, the New Jersey act make

of compensation in fatal accidents dependent upon the of dependents only, but irrespective of the degree of hip—so much is given to one dependent and a somegher amount in case of two dependents, and so on. putation of the cost of fatal accidents would present difficulties except for the data available from the ton table. Always remembering that a distribution Jersey between single and married persons would be from that in Washington, it may nevertheless be that both of these groups independently indicate the of cases leaving from one to five or six dependents, and wing table may therefore be used, in which the cases Jersey are arranged in proportion to the cases in ton:

	Married Wash.	Per Cent.	Married N. J.	Single Wash.	Per Cent.	Single N. J.	Total N. J.
...	800	26.6	175	440	49.2	39	214
....	711	23.7	156	338	37.8	30	186
...	628	20.9	137	49	5.5	5	142
...	413	13.7	90	32	3.6	3	93
.	240	8.0	52	13	1.5	1	53
...	213	7.1	47	22	2.4	2	49
...	3,005	100.0	657	894	100.0	80	737

ODS OF APPLICATION OF THE STANDARD TABLE.

ms proper to conclude this study of the Standard Table with a brief outline of the methods by means of table may be used for determining the comparative compensation acts. In general, the method consists ul valuation of the 100,000 accidents according to the s of each compensation act. The table is sufficiently o permit such a valuation, and in most cases, it is that no additional information is necessary though ed may arise occasionally. Any experienced actuary nabled to make such computations with the aid of at hand.

mparison of the costs of different acts is much simassuming a week's wages as a unit rather than dollars , because almost all benefits in compensation acts are

expressed in terms of weekly wages, and on the other hanc
premiums are computed in percentages of the pay roll, sc
in this way any differences between state and state v
might arise from differences in wages would be eliminat
the computation. It is evident that in comparing the co
two states, the differences in wages may be disregarded be
they will be automatically corrected in the premium ra

The computation of the cost of cases of temporary
disability appears very simple by the aid of the series sho
their distribution by duration. This series being detailed
intervals of one week only, it is quite safe to assume tha
average duration of a case in each group is equal to the
of the limits of that group. Then the waiting period ma
deducted from the average duration for each group, an
the compensated period the proper percentage of w
whether it be 50 per cent., 60 per cent., or any other percen
may be computed. One can readily see how easy it is to
pute the cost of any changes in waiting period or in the
ment of these cases by applying the table as indicated.

The cases included above do not represent the entire ex
for temporary total disability. In every case eventually
ing to permanent partial disability, including cases of dis
berment, there is a preceding period of total disability v
often is compensated for independently of the benefit
the permanent partial disability arising subsequently.
method of valuation which may be used for this part c
cost of the cases is identical with that used for the prec
group. The same conditions of waiting period apply
The most important fluctuation between states refers t
question of dismemberment, since in some states it is defin
provided that the so-called specific dismemberment be
are exclusive of any other payments. In such states, ther
this additional cost of temporary total disability in dismen
ment cases may be disregarded.

The cost of dismemberment cases can be computed
easily by means of the table giving the distribution of th
memberment cases, since almost all the compensation
contain a definite schedule giving the amount of benefits
able for each kind of dismemberment. Since payment

some of the graver cases of dismemberment are for fairly long periods, the question of commutation of future payments arises. It is true that in the past it was not customary to take into consideration the difference between present and future values in computing the experience in the casualty business. It seems necessary, however, in actuarial work in connection with compensation problems to introduce this factor of the commutation. Under old liability conditions, neither the amount of payments to be made nor the time when they were to be made could be foretold in advance with any degree of accuracy. Therefore, the addition of all payments made no matter when was assumed to represent the true cost. Whatever profit was made as a result of deferring payments went into the investment account, and for this reason insurance companies were often able to earn a profit although showing a loss in their underwriting accounts. Compensation legislation makes the period of payments quite definite, and wherever it may seem advantageous to settle in lump sums in advance of the time when payments are due, most of the laws require the commutation of such payments to be made according to definite rules. It is therefore necessary to take account of such differences between present and future values. It is quite evident that the increase of the benefit periods from five years to ten years, for instance, would not necessarily be equivalent to a doubling of the cost, not only because of the lower value of deferred payments, but also because of the possible effect of mortality, as in most compensation acts benefits cease on death of the injured person or the beneficiary from causes other than due to the accidental injury. Moreover, in cases where life pensions are granted, as for instance to widows in some states and to cases of total permanent disability in a great many other states, it is quite impossible to compute the cost at all unless the actuarial factor of present value of annuities is taken into account.

In computing the cost of permanent partial cases other than dismemberments, the distribution of such cases by degree of disability is useful because the amount of benefits would be expressed in a percentage of the weekly wages proportionate to the degree of disability. A short-cut method seems to be

indicated by computing the average degree of disability f
cases of this group. The cost of these cases will then be
erned by the scale of compensation contained in the act, b
number of these cases, and by the number of weeks for
benefits under this provision must continue. As a mat
fact, it is probable that in only a small percentage of cases
our experience will permanent partial disability be com
sated by very small weekly benefits. Much more likely
commutation of such cases, except the very severe ones.
that should not influence the cost of the commutations
under supervision of Accident Boards or Commission
the present value is presumably computed in accordance
the provisions of the law.

As far as the few but expensive cases of permanent
disability are concerned, the method of computing the
may be the same as that for permanent partial disability e
that cases being those of total disability, there is no que
as to the degree of disability, and the full value of the
pensation scale is payable in such cases. Wherever the
ments are limited in the law to a certain number of we
temporary annuity for that period may be computed wh
the few other states providing life pensions, life annuity
be figured on. Almost without exception these benefits
on death not due to the accident, which of course wou
taken into consideration in figuring either temporary
annuities.

In regard to fatal accidents, there may perhaps be
variations between different states than for any other g
In some states the computation is simple enough because
fits are given for a limited number of weeks and be
beneficiaries are not specified and the same benefits are
no matter how many total dependents survive. Under
conditions and especially when the duration of payments
a short term of years only, the mortality factor of depen
may be discarded on the assumption that if one depen
should die others would survive and appear to claim th
maining benefits. In a few states special computa
become necessary as to the number and kind of depen
surviving, but it is believed that the material furnished i

study will be sufficient to meet most of the exceptional conditions arising out of different acts. Perhaps the greatest difficulty may arise in connection with the valuation of the factor of re-marriage, as is well remembered by all who were observing the preparation of the New York compensation rates. The thorough discussion of the problem of re-marriage at the time indicated the actuarial difficulties arising out of this problem, but since the New York Workmen's Compensation Commission has issued actuarial data for computing the pensions to widows subject to death and re-marriage, these may be utilized in a comparative study. It seems scarcely necessary to point out that such use of the tables for purposes of comparison may be justified, even if for purposes of valuing individual cases and for buying or selling such annuities, the accuracy of the tables may be disputed by some, as has been done.

Burial benefits are granted in some states only in case no dependents survive and in a few states in all cases of fatal accidents. The standard table provides an easy method for accounting for this difference in state laws. Since, however, burial benefits are stated in the act in dollars and the entire computation may be made here with the weekly wages as a unit, it may be necessary to convert the cost of burial benefits into weekly wages by assuming or ascertaining the average weekly wage for injured persons in the state.

When the cost of compensation of the hundred thousand accidents has been computed in terms of weekly wages, an interesting problem arises in connection with the effect of the minimum and maximum provisions. All compensation laws contain some such provisions which are often referred to as "limits." By this is meant the provision of the act limiting the maximum weekly benefit that may be granted irrespective of the wages and also establishing a minimum, in case the regular scale granted by the law would produce an amount insufficient even for the direst needs of the injured or his family. Like all other provisions these limits vary greatly. Perhaps the most frequent type is that of $5 to $10, though the minimum falls in one or two states to $4 and it rises in some of the western states to $6. The maximum provisions are often increased to $12 and in some states to $15 a week. There has

been a good deal of discussion as to the results of these upon the cost of compensation. Commissions have argued that the maximum limit materially reduces the be provided and therefore the cost, while on the other hand, ance men have frequently claimed that minimum prov are an additional burden of great magnitude.

As far as the writer knows no specific method of mea the results of such limits has ever before been suggested. these limits cannot be disregarded in comparing the cost acts, a method of fairly exact measurement is presente which is convenient because of its simplicity, provided suf data are available. These consist of some statistics distribution of injured persons according to wage group. as to the average wages, so common in American stat literature, would be of no advantage in this conne Given the distribution of injured persons by wage group method is to compute the average benefits which wou granted to the total number of injured persons included table (or to 100 injured employees if the table has bee verted to a percentage basis) if there had been no Then a similar computation is made to obtain the a benefits granted with proper regard for limits, by incr the benefit up to the minimum limit for the lower wage and cutting them down to the maximum limit in the wage groups. If the statistics of wages by groups is suffic detailed, the mean wage of each group may be safely acc as the average. When these computations are made a parison of the total benefits which would be payable entire group without any limits, and the benefits ac payable with due consideration to the limits, would in the measure of influence of the weekly benefit limits, may be an additional charge in some cases or a discou others.

The greatest difficulty in applying this method is in o ing necessary data as to the wage distribution of injure sons in various states. Such data are gradually being nished by the Workmen's Compensation Commissio Boards which report statistics of accidents according t wages of the injured as well as in a great many other

In other cases special investigations may be found in the reports of respective bureaus of labor statistics. It is believed that such data are available at present for a few states, as Massachusetts, Minnesota, Illinois, California, and others. In a case of adjoining states, it may be safe to assume the wage scale to be fairly uniform throughout the larger territory.

In general, the effect of the lower limit is to increase the cost of compensation and the effect of the maximum limit is naturally in the opposite direction. The effect of the two limits being contrary to each other, the results seldom indicate any very large correction for limits, at least as far as weekly benefits are concerned. With the 50 per cent. benefit scale it will be found that the minimum limit has greater importance in increasing the benefits than the maximum limit in reducing them, and therefore as a rule it may be said that in states having a 50 per cent. benefit scale the results of the limits will be an additional charge upon the cost of compensation. On the other hand, where the scale of compensation is two thirds or anywhere near it, comparatively few cases fall below the minimum limit, while the maximum may decrease the cost in a great many cases. As a result a cheapening of the cost is sometimes produced by low limits when a two thirds scale of compensation obtains. Thus, for instance, a $10 maximum limit is of very little effect in reducing the cost where the benefit scale is 50 per cent., but it does effect a substantial saving on a two thirds benefit scale.

More complicated are the problems created by the maximum limits established in the acts for the total amount of compensation payable, which apply particularly to cases of death and permanent disability, when the money limit is such as to cut down the period for which benefits may be paid, in all cases where the weekly benefit is a little larger than usual. In other words, the money limit reduces the number of weeks for which compensation may be paid in certain cases, the effect of the money limit depending largely upon the wages. It is evident that the final effect of such maximum money limits depends upon the number of cases which will be affected thereby. In other words, it depends largely upon wage distribution. In order to ascertain, therefore, the effect of such

money limits, it may be necessary to distribute the number of cases subject to the provision by wage gr compute the cost of all cases both with and without consi tion to the maximum limits, and in that way give p weight to the effect of the limits which may be exercised in a few of the cases.

Finally, after the cost of compensation payable in the dred thousand accidents is computed, the question of the of medical benefit remains. It is readily admitted that the cost of medical and surgical aid represents a very sub tial part of the total cost of compensation, it is very diffic estimate such cost from the provisions in the acts thems and therefore it is impossible to apply the standard method for ascertaining the cost of medical benefits. It s that for this part of the cost it is necessary to revert to d experience. For Massachusetts and one or two other s a certain amount of experience is available which indicate proportion between the cost of compensation and the co medical aid, and the proportion may be utilized to loa cost of the hundred thousand accidents as ascertained a by the proper percentage for medical aid. It is true tha provisions for medical aid are subject to some varia between states, and nothing better than an estimate by j ment as to the value of the differences in the provisions o act and the other, can be suggested here. Fortunately, ever, the difference in provisions for medical aid is not so as that for other features of compensation acts, and any p ble errors would not greatly affect the final results.

The methods which may be used in computing the com tive cost of different compensation acts by comparing the of the hundred thousand accidents in different states, been described here in sufficient detail to enable indepen students of the problem to apply them. Theoreticall students should get exactly the identical result while wo independently. As a practical matter it is hardly fa expect that, because inevitably some little differences of j ment may arise. There is, therefore, no intention to that all the details of the method presented here are infal There can be little doubt that the actual experience of

pensation insurance in this country, after sufficient time has elapsed to permit its careful study, may introduce some corrections in the table itself or in the results as obtained from the table. There may be differences in interpretation of the law in different states, which are not evident in the language of the acts themselves, and when the problem is to ascertain the comparative cost of the Compensation Law before it has even gone into force, it is evident that no account can be taken of such differences of application of law. Since the Standard Accident Table depends upon an assumption of a fairly well distributed industry, it is possible that in some states in which certain industries predominate, they may affect the Standard Table itself. These and other qualifications must be kept in mind when applying the Standard Table or the methods as indicated here. The eventual accuracy of the results will depend upon the development of proper accident statistics in this country, but the claim is made for the table and the method as outlined here that in the absence of more accurate statistical data, it is the only one by means of which proper actuarial work in connection with compensation problems can be carried on at the present time.

THE STATISTICAL WORK OF THE UNITED STATES GOVERNMENT.*

By Walter F. Willcox, Ph.D., LL.D., *Professor of Economics and Statistics, Cornell University.*

This is the first time that the American Economic Association and the American Statistical Association have met in joint session and the second time that they have in coöperation considered the topic which is now our theme. The memory of some older members of the two Associations instinctively runs back this morning to the time, more than eighteen years ago, when joint committees of these Associations met around a table in New York to consider the terms of a memorial to Congress in favor of a permanent Census Bureau. The attendance was large and representative; the sessions prolonged and animated, not to say stormy. Finally, the committees reached substantial agreement and the memorial then drafted exerted, I believe, an appreciable influence upon the decision of Congress five years later to make the bureau permanent.

Two earlier precedents are even more encouraging. The first significant improvement in American census practice was made in 1800, with the purpose of testing the health and longevity of the American population. An age classification of the free whites into five periods was then introduced. This concession to non-political considerations resulted directly from petitions originating with the recently reorganized Connecticut Academy of Arts and Sciences, and effectively supported by similar petitions from two older and more influential learned societies, the American Academy of Arts and Sciences at Boston and the American Philosophical Society, located at the seat of government in Philadelphia and under the presidency of Thomas Jefferson, then Vice-president of the United States.

The longest forward step ever taken by Federal statistics was probably that between the censuses of 1840 and 1850.

* Paper presented at a joint meeting of the American Economic Association and the American Statistical Association Princeton, N. J., December 30, 1914.

'he changes then introduced were due in no slight degree to he egregious blunders in the census of 1840, to which stu-ents had called attention, and to petitions for an improved ensus emanating from the New York Historical Society and he then youthful American Statistical Association. In now ebating the condition of federal statistics, with a view to etermining our individual responsibilities as scholars and ur collective responsibilities as learned societies towards ts present and future status, these Associations are following line of notable and cheering precedents.

If one hopes to contribute individually to the improvement f federal statistics, the first essential is a thorough knowledge f the actual conditions under which the work is done and of he field of inquiry with which the figures are concerned. t is seldom possible to get this knowledge from printed official eports. For example, the census of 1870 reported that 12 er cent. and that of 1910 that 21 per cent. of American 'egroes were mulattoes. The obvious interpretation is that hese two races have been intermingling rapidly since the ivil War. We are not informed that in 1910 for the first ime many of the enumerators employed were Negroes, that rivate inquiries conducted by Negro enumerators have shown proportion of mulattoes much greater than census returns f similar date and place, and that this administrative inno-ation may explain much or all of the reported increase of ulattoes. The figures do not prove and perhaps hardly rengthen the inherent probability that miscegenation has ncreased.

How many members of our Associations who use the sta-istics of immigration know, what they could hardly learn rom the reports of the Bureau of Immigration, that the eaning of the word *immigrant* as its statistical unit has een several times altered by bureau circulars and the compara-ility of the figures for the successive years disturbed? How any know that until recently an immigrant "bird of passage" as counted as an immigrant when he arrived in the spring, as not counted when he departed in the fall, and was counted gain as often as he returned? *

*See the writer's "Our Gain in Population Through Immigration" in *National Civic Federation Review*, ov.-Dec., 1906, p. 7.

Closely related with this need for a thorough knowledge of any inquiry whose results one uses is the need for measuring or estimating the amount and direction of the error in the results. This is quite other than the probable error with which mathematical statists are concerned. It seeks to learn whether the reported figures are above or below the truth and by how much. In a complicated series of inquiries each set of answers has its own margin of error, and an estimate of one throws little light on another. The reported number of married women is slightly too large because for a woman to allege marriage is to state a claim; the reported number of divorced women is far too small because such a report is a confession of fault or failure.

The greater the importance of one's statistics for the purpose he has in hand, the stronger becomes the need of determining whether they may be trusted to the degree implied in the argument, just as the taller the building, the deeper and firmer must be its foundations. Is there no danger that towering and impressive constructions of economic speculation are being erected both in the United States and in Europe with too little effort to make sure that the statistical foundation is bed-rock? Is there no danger that some of these may prove ultimately to be ill-founded? This is a peril against which mathematical statists may need to be warned. To voice that warning, I cite two examples from the mistakes of mathematical geniuses.

Before and for many years after 1790, when the United States took the first national census on record, the opinion was current among European statists that to enumerate a country's population was impracticable. Needing to know the population of France, Laplace secured a count of the residents in certain scattered districts and also of the annual number of registered births. These facts gave him a ratio between births and population which he applied to the whole of France. The process was legitimate, but in defending it Laplace went into an elaborate mathematical demonstration showing with pages of formulæ that there was not one chance in one thousand that the error of his estimated population would exceed 500,000. Today it is demonstrable that his estimated popu-

on was under the truth by more than 2,000,000, or 9 per t. of the total, and that the mistake lay not in his mathetics but in the number of registered births in France, to ich he applied his ratio.*

f any mathematician held a position in the United States he end of the nineteenth century comparable to that held Laplace in France at its beginning, it was probably Simon wcomb. Because of his eminence, I venture to feather warning shaft with an example from his statistics. In brief *Statistical Inquiry into Sex in Human Offspring*† a n object was to show that "the treatment of statistical a generally on a large scale by the rigorous methods of bable induction leads one into a field the cultivation of ch promises important results to the science of the future."‡ first of his six conclusions was: "The preponderance male over female births probably varies with the race . . it seems to be either non-existent or quite small he negro race." This conclusion was founded entirely n census figures§ which are subject to a margin of biased r, so wide that they have no probative value. Furthere, the conclusion is directly contradicted by the few erican registration figures of births by race and sex,—to ch no reference was made, although the best of them were lished by the city in which the article was probably tten.

he keen interest in economic or statistical theory, which resses itself more and more often in a mathematical s, is not infrequently associated with a distaste for the ient and competent testing of the basic facts. This

e earliest and fullest statement of Laplace's argument is in his contributions to *Histoire de l'Acad-Royale des Sciences* for 1783, printed at Paris in 1786. After several unsuccessful inquiries of the American libraries, these volumes were found in the library of the American Philosophical Society ladelphia, which kindly sent them to Ithaca for my use. Laplace clung to this method at least until when his *Essai Philosophique sur les Probabilités* appeared (See *Oeuvres Complètes*, 1843–47, Vol. VII, ., f.) and his disciple Quetelet until 1827, when its keen criticism by de Keverberg won Quetelet over method of enumeration, of which he soon became the most convincing and effective advocate. iticism applies to the form of Laplace's estimate set forth in his *Essai Philosophique*, when it can be by census and registration figures. For evidence that his estimated population of France, 28,352,845 2, was below the census figures and that those were below the truth, see Jacques Bertillon's *Stat. . résultat des Recensements* (1899), pp. 30 31.

mon Newcomb, *A Statistical Inquiry into the Probability of Causes of the Production of Sex in Human ring*, Carnegie Institution of Washington, 1904.

d., Prefatory Note.

d., p. 6.

neglect may lead to building structures on foundati
sand and to compromising the reputation of our gu
their collapse. Certainly the contrast between the
tude of the superstructure and the slipperiness of the f
tion is often glaringly apparent to those who have st
in deep waters to lay the foundation and is in no slight
responsible for the attitude of quizzical aloofness with
these structures are viewed by some who know much
their basis.

I dwell upon this suggestion because I have long beli
to be needed and perhaps never more than now when th
ing enthusiasm for mathematical statistics in Europ
the United States and the inability of many produ
official statistics to follow or criticize intelligently the
pretation placed upon their own figures may result in r
a separation, which I hoped was of the past, into gr
official and private statists, each somewhat ill-informed
the other.

The most serious obstacle to sound work in feder
tistics is probably the over-emphasis upon its political a
All official statistics are political and in a sense p
they cannot be entirely divorced from politics with
future period of importance to the present discussi
for a century their scientific or rational meaning ha
slowly gaining recognition. This change it is the du
privilege of our Associations to support and urge f
To that end we need to provide in our universities
training for statists, public or private, and to instil int
a sense of the scientific value of their work. We need t
cise an influence in favor of long terms of service for
who have earned retention and for the promotion o
who show natural aptitude. Perhaps nothing would
this purpose better than to see some of our large offi
come training schools in producing the future official
of the country. They are not now trained in our univ
and they cannot be well trained without enjoying the l
tory experience of a well-managed office. Universiti
uated near such laboratories might profitably arrange
oration, with them, like that between medical schoo

hospitals or that between many European universities and the statistical offices of the cities in which they are situated. In this respect the Bureau of the Census has proved a disappointment. It has done little to train men so that they could rise to higher positions in the office and in so doing lift the office staff to higher levels of efficiency; much less I believe than the Coast Survey or the Geological Survey or the Bureau of Corporations has done. Largely as a result of this overemphasis upon the political aspects of its work and neglect to train men for promotion, the quality of federal statistics is not improving as fast as the quality of statistics in private corporations or the quality of federal work in geology or geodesy. Perhaps, indeed, the deterioration is absolute as well as relative.

What should these Associations do toward improving federal statistics?

For the present, I have but one suggestion. It would be expedient, I believe, for each Association to appoint a committee on federal statistics, with power to enlarge its membership, and to coöperate with the corresponding committee of the other Association. These two committees might divide the field of federal statistics between them and start a person at work if possible on each main field. Each coöperator would be invited to prepare a report on the recent progress and present condition of statistics within the field assigned him and to embody recommendations for its future improvement. The reports would be laid before the main committee for editing. Those which received its approval would then be submitted to the Associations for printing.

In this manner our Associations might secure for themselves and the public a series of deliberate, reasoned and expert opinions upon the subject of our conference. If this effort should prove successful, it would aid us in deciding whether further steps were desirable. Perhaps the time would be found ripe for an expression of opinion from one or both of these Associations regarding federal work in statistics or certain branches of it which would influence it helpfully in the future as similar expressions of opinion from these and other learned societies have helped it in the past.

HOW THE STATISTICAL OUTPUT OF FEDE BUREAUS MIGHT BE IMPROVED.*

BY W. C. MITCHELL, PH.D., *Professor of Economics, Columbia Uni*

Professor Willcox remarked incidentally that no m in a position to criticize the statistical work done b federal government unless he knows intimately the set of processes by which the final results are obtained- the original data are collected in the field; how they ar ulated, summarized, and averaged in the office; and ho textual explanations of the tables are prepared. I c heartily in the justice of this observation. By rights, it me out of the discussion. For despite three brief peri employment by federal authorities—the Census Offic Immigration Commission, and the Bureau of Labor Sta —I have but a limited acquaintance with the product federal statistics. It is as a consumer of statistics t speak—primarily as a consumer of statistics of price wages—and I recognize that the consumer's impre may be mistaken. However, I give them for what the worth.

The field work of collecting data respecting prices and seems to me better on the whole than the office work of m these data into finished bulletins. For in the bulle have found much that is not clear, and not a little t patently misleading or flatly wrong. But in so far as I been able to test the original data I have found that th consistent among themselves and consistent with s figures compiled by other investigating authorities. In they seem to have been collected honestly and intelligen

The reason for the relative inferiority of the office appears to lie in the organization of the office force. chiefs of the bureau which has done most work in thi ticular field have all been forceful and capable men. clerical force has stood on a level rather above that co

* Remarks made at a joint meeting of the American Statistical Association and the American Association, Princeton, N. J., December 30, 1914.

ment offices. But this bureau has lacked an ade-
ff of skilled statisticians capable of understanding
se of an investigation, and of directing the work
rks under the general supervision of the chief, of
he most intelligent use of the data collected by the
ts and of preparing lucid text which tells what the
n. It goes without saying that the head of a bureau
e personal supervision to all the many tasks imposed
office; and if he has not assistants who are really
vestigators trained in the use of statistics, much of
urned out will be mediocre in quality.

akness of the organization in this respect arises
act that the bureau concerned can not offer a satis-
reer to capable men. Adequate salaries can not
adequate recognition can not be given. A few
e quality required have stayed by the bureau year
, and worked efficiently under most discouraging
nces. These individuals merit more honor than
ever receive for the sacrifices they have made and
they have rendered. But their number is by no
equate. The efficiency of a government bureau
maintained indefinitely by exploiting the statis-
siasm or the patriotic philanthropy of its staff.

right about the chief cause of weakness in the sta-
rk done by the government, the remedy lies in the
Congress. What we may do as individuals to aid
of the statistical bureaus in securing adequate
ions for their staffs is not much, but it is better
ng. By using the statistics which are already being
we can show that there is a public demand for
this character. By using this material critically,
ow that there is need of improving the product now
By seeking to put the blame for such faults as
upon the proper shoulders, we may perhaps bring
ome members of Congress the necessity of making
vision for the support of statistical work. If we
plish something in this direction as individuals, as
f the American Statistical and American Economic
ns we can accomplish more. Accordingly, I endorse

heartily the plan of coöperative effort which has been outl by Professor Willcox. But I anticipate that his comm will find that the measures of greatest practical promis improving the statistical work now done by the govern lie along the line which I have suggested.

THE STATISTICAL WORK OF THE UNITED STATES GOVERNMENT.*

By E. Dana Durand, Ph.D., *Former Director of the Census.*

Much might be said regarding the need of extensions of the field of federal statistical work. The most important additions immediately desirable are perhaps annual statistics of manufactures and of agriculture. We already have annual returns, based on actual enumeration and not on estimate, of the mining industries and of cotton ginning, and until recently we had annual returns of lumber cut. There is an equally strong demand for annual data, promptly published, of leading manufacturing industries and of the principal crops and domestic animals.

The need for current data regarding agriculture is by no means satisfactorily met by the estimates of the Department of Agriculture. The margin of error in these is extremely large. The principle followed in arriving at the acreage of crops and the number of domestic animals is to take the decennial census as a starting point and to add or subtract annually estimated percentages of change as compared with the preceding year. These percentages represent merely a consensus of guesses. An error in the estimate for one year continues to affect the figures for each succeeding year until the next census. Since errors in estimates tend, owing to psychological reasons, to continue in the same direction for a series of years, the cumulative error may become very great. For some states the estimates of the Department of Agriculture as to the acreage of certain crops for the year 1909 were several times greater than the figures returned by the census. In some other states the Department's estimates were as much as 50 per cent. too low. For the United States as a whole nearly all estimates were found at the time of the Twelfth Census to be materially too low and nearly all those at the time of the Thirteenth Census to be materially too high.

* Paper presented at a joint meeting of the American Economic Association and the American Statistical Association, Princeton, N. J., December 30, 1914.

The error in the agricultural estimates would, of course, be reduced by a quinquennial census of agriculture. By a law of 1909 the Census Bureau was authorized to take a simple agricultural census in 1915 and every ten years thereafter, but the present Congress has thus far shown an indisposition to provide the necessary appropriation. In any case a quinquennial census would be only a palliative, not a remedy for the existing evils.

Annual statistics for leading crops and domestic animals, based on actual returns of farmers, would involve comparatively little expense. The rural mail carriers, who cover by far the greater part of the cultivated territory of the country, could collect the data. In course of time it would become possible to induce most farmers to fill out the schedules themselves. The Department of Agriculture recently made an experiment with this method. The proportion of farmers who filled out the schedules delivered to them by the mail carriers was comparatively small. The results of this single experiment, however, do not seem conclusive. There was no law compelling farmers to fill the schedules and farmers were unfamiliar with the scheme. A compulsory law may possibly be unwise at present. Even without it, the system should work fairly well after a few years' experience. In any case the value of accurate annual returns of agriculture would be so great as to justify considerable expense.

The inadequacy of a quinquennial census to show accurately even the general trend of manufacturing industries is obvious, while it completely fails to disclose current conditions. Were an annual canvass of manufactures undertaken it would become year by year increasingly possible to secure the returns by correspondence. This is the method used for the most part by the Geological Survey in obtaining data for mines. It has also been successfully used for manufactures in Massachusetts. The schedules for annual returns might well be far simpler than those used at the quinquennial census of manufactures. They might be confined to inquiries as to the quantity and value of the leading individual products and as to the number of wage-earners, leaving inquiries as to capital, expenses, materials and the like, if such are deemed necessary at all, for the quinquennial or even the decennial enumerations.

In this connection it should be noted that even the elaborate quinquennial censuses of manufactures fail to present a great deal of information which is in great demand. As regards many industries, there has been no attempt to ascertain the quantity or value of specific products. While, for some of these industries, it is scarcely practicable to obtain such data, there are others for which they could be obtained. Moreover, there is much demand for information regarding industries more narrowly limited than those distinguished by the census classifications. Owing to the fact that several branches of business are often carried on by a single establishment, the Census Bureau has more and more adopted the policy of classifying establishments according to very broad groups. When tariff bills, for example, are under discussion, information is demanded for specific industries, not groups of industries. Such information could be compiled and published at least for selected establishments which are free, or largely free, from the complexity of overlapping.

The president of the American Statistical Association, in his annual address, suggested the desirability of a committee of expert statisticians to serve as an adviser to the statistical bureaus of the federal government. Other speakers have touched on the same thought. Doubtless a good deal could be accomplished by the creation of a joint committee of the American Economic and American Statistical Associations holding no official relation to the government. Still more, however, could be accomplished by an advisory commission created by the government and comprising statisticians and economists from the universities and other experts who should devote only a fraction of their time to the work, as well as officials continuously employed in government statistical investigations.

In order that the work of such an advisory body should be of the greatest value, its members would need to devote a good deal of time to it and to incur considerable travel expense, both in mutual consultations and in conducting investigations at Washington and elsewhere.

It will be recalled that these two associations at the time when preparations were being made for the Twelfth Census,

organized a committee to make suggestions. For th
part the work of that committee consisted of mon
prepared, wholly or substantially, by individuals. U
these were, they were less useful than would be report
on extended consultation and discussion. The hol
such consultations by members of a widely scattered co
means time and travel expense.

Moreover, it is essential for any proper criticism
federal statistical work that the critics should tho
familiarize themselves with the actual methods of the
statistical bureaus—the methods of collecting the
data, of editing the schedules, and of tabulation. The
know about tabulating machinery, about processes, an
costs. They must examine original returns and gain so
as to the margin of error in them. Statisticians ou
the government service are altogether too lacking in i
tion on such points as these. In most branches of st
work we need at present, far more than any extensio
field or any improvement in the methods of analy
increase in the degree of accuracy of the raw material
very largely to this task that such a proposed co
should at first address itself. Obviously, in order
committee of experts should secure the necessary i
tion on which to base recommendations along this
would be essential for them repeatedly to visit Was
and to incur considerable expense.

An official commission established by the governmen
presumably be able to secure appropriations for exp
this character. Further advantages of such a com
would be the fact that it would have more complet
to information than an unofficial committee, and the f
its recommendations would doubtless have somewhat
weight with administrative officers and Congress.

It is possible that the necessary expenses of an u
committee on federal statistics might be provided
private subscriptions. Should the proposed joint co
of the Statistical and Economic Associations find it
to coöperate with various commercial and business o
tions, which are likewise interested in the improve

government statistics, these organizations might aid financially in the work.

The present time is hardly propitious for legislative or administrative action creating an official advisory commission on statistics for the federal government. Every effort is being made to reduce expenditures. The first step is clearly the creation of a joint committee of these two associations and action looking toward an official organization should be deferred until a more suitable time. The joint committee might well consider the elaboration of a plan for such statistical commission as part of its task.

A third topic to which I wish briefly to allude is that of coöperation between the federal government and state and local governments in statistical work. To some extent, coöperation may properly take the form of the employment of state or even municipal agencies to collect statistics for use by both the local and the federal governments. The Massachusetts Bureau of Statistics has to a large extent acted as an agent for the federal Census Bureau in this way. Unfortunately, however, the standard of statistical work in most states and cities is not so high as that demanded by the federal government and the extension of coöperation of this type can be gradual only.

On the other hand, it would seem possible for the federal government to coöperate extensively with the state and local governments in another way, namely, by rendering available for special local uses the original data collected by the federal government itself for more general purposes. There is great demand in some states and cities for the presentation of more details as to small localities than are published by the federal government. This is notably true with respect to the censuses of population, agriculture, and manufactures. For example, a reasonable amount of detail regarding population and agriculture is desirable for townships; the Census presents data only for counties (except, of course, that the number of inhabitants is given for townships).

The federal government properly feels that it cannot afford to tabulate and publish information as fully for small areas as it does for states or for the country as a whole. It should,

however, be willing to place the results of its canvass
disposal of the states for the purpose of more detailed
presentation or at the disposal of individual cities, co
or other local governments. The federal government
offer the state or local governments gratis the original sch
after it had finished with them. It might furnish,
promptly, duplicates of those schedules, the cost of
would be low, to be borne locally. Again, the federal g
ment might, on request, itself tabulate and publish the
details at the expense of the states or local govern
None of these plans can be satisfactorily carried out w
new federal legislation. At the last census there were
ber of cases in which states or local governments were
to bear the expense of special tabulations or of copying
ules. The census officials were perfectly willing to
with their wishes, but found it almost, if not quite, imp
to do so under existing provisions of law, as to confi
treatment of returns and as to financial procedure.

Much of the raw material of statistics collected
federal government is only partially utilised at p
Valuable metal is left in the ore. Further local elab
of this material would in many cases be more useful to
and local governments than the special censuses and
statistical investigations which they themselves und
Coöperation is the obvious thing. Of course it wo
possible also for the federal government, under prope
ditions, similarly to make its statistical resources availa
private organizations and even individuals.

FEATURES OF THE STATISTICAL WORK OF THE BUREAU OF LABOR STATISTICS.*

r ROYAL MEEKER, PH.D., *Commissioner of the Bureau.*

e with much that Professors Willcox and Durand have believe that it is desirable to secure comparability inuity in our statistical output. In revising the statis-k of the Bureau of Labor Statistics I have kept these mind and, so far as possible, have constructed the es of price and wage indexes so as to admit of com-with the old indexes. The new wholesale price mber will be calculated back to 1890 so that the old d the new may be compared throughout the whole nce 1890. The retail price index, however, has been d back only to and including 1907, for two reasons: cause of the enormous amount of labor involved and ficient force and funds of the Bureau, and, second, ince 1907 retail prices have been much more accurately by merchants than previously, greater care being to obtain the actual sale prices on the 15th of each the same grade of each commodity sold by each store. e quotations before 1907 and since that date are so that comparisons cannot fairly be made. No good can be served by calculating the relative prices and mbers back of 1907. Such a continuous series of and indexes would give merely a fictitious compara-d continuity to retail price statistics, the prices them-ing discontinuous and incomparable.

my desire to carry back through 1907 the new index showing changes in hourly rates of wages, full time rnings, and weekly hours of labor in different indus-n some industries, however, the number of establish-porting in 1911 was greatly increased over the num-910, so that no fair comparison could be made going 1911. It is unfortunate that the relatives and index

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numbers cannot be carried back in every instance to 18
I feel that it is better to make no comparisons of wag
prices rather than to make erroneous comparisons by m
a fictitiously continuous series of relative prices, wages
ings, and hours of labor.

I sincerely hope that the proposed joint committee
Economic Association and the Statistical Associati
advise with the statistical bureaus of the government,
appointed. Unnecessary duplication of statistical work
be eliminated, and the statistical methods used sho
standardized and made uniform. Especially is sta
zation and uniformization of methods needed in the d
commonwealths of the United States. For examp
accident statistics of one state cannot at the present t
compared with the accident statistics of any other state b
the statistical methods are so utterly at variance.

The various statistical bureaus in the federal serv
getting together as never before so as to avoid duplica
effort and to agree upon the right things to do and th
way to do them. I am trying to prevail upon the
state agencies to coöperate with the Bureau of Labor St
and with each other in the gathering of statistics of acc
unemployment, retail prices, wages, and hours of labor

It is slow and discouraging work, but great good will
if we can agree upon what statistics should show and t
methods of showing what is wanted. The committe
gested would be of great service in establishing proper s
cal standards, in calling attention to the enormous q
of costly and useless statistical output, and in elim
duplication of work and the confusing and costly publica
more or less contradictory statistical stuff by various
and state agencies.

Most treatises on statistics deal exclusively with sta
methods. Nothing is said about the data to which
statistical methods are to be applied. Now all exp
shows that the principal source of error in statistical w
in the original figures collected to represent wages,
hours of labor, etc. It is much more important that
attention to the gathering and verification of the origina

we devote our efforts to hair-splitting refinements
thods of treating the facts gathered. With all the
n statistical methods, however, we have not learned
ence between right methods and wrong methods in
tical analyses. In fact, the treatises themselves are
very vague or perfectly noncommittal as to the
ity of a given statistical method to a given set of
. Some writers seem to think that it really doesn't
ter what statistical methods we employ, as approxi-
e same results are obtained by any and all methods.
old this comfortable view. I believe there is a right
wrong way of doing things. I believe it is of first
e to get our facts right, but I am convinced that the
ragible facts are sometimes made to tell lies because
reated by wrong statistical methods.

fore I took charge of the Bureau of Labor Statistics,
ome very suspicious of the Bureau's index numbers,
its retail price index. Some people here present will
recall that I was wont to have fun with the Bureau's
bers. I no longer have fun with them—they have
ne. As soon as I took charge of the Bureau, before
settled in the saddle, I set about to revise and recal-
index numbers published by the Bureau. Perhaps
ou will recall receiving more than a year ago a letter
Commissioner of Labor Statistics—a S. O. S. call for
id not have the self-assurance to set about revising
numbers without first taking counsel with those who
qualified to advise me in this matter. Many of you
ved this distress signal may remember carefully
it in your waste basket. At least I received no
a number of economists and statisticians whom I
Most of you who did reply may remember dictat-
ectly perfunctory reply which revealed either that
ot know or care much about index numbers, or that
t wish to prolong your correspondence with the Com-
of Labor Statistics. I want here and now to acknowl-
licly the assistance given me by Professor W. C.
and Professor Irving Fisher. Had it not been for
athy, encouragement, and counsel of Professors

Mitchell and Fisher, I should not have had the courage to carry out the recasting of the Bureau's index numbers. I have changed the methods employed in constructing the index numbers and shifted the base period from 1890–99 to the last completed current year. It has been a most laborious and tedious undertaking, but the work is now nearly completed.

That the method used in constructing index numbers is not an inconsequential matter is shown by a brief examination of the following table:

PRICES OF POTATOES FOR MAY, JUNE, AND JULY, 1913.

1.	May.		June.			July.		
Firm.	2. Price.	3. Relative on May base.	4. Price.	5. Relative on May base.	6. Relative on June base.	7. Price.	8. Relative on June base.	9. Relative on May base.
804	$0.20	100	$0.40	200	100	$0.30	75	150
808	0.17	100	0.36	211	100	0.32	89	188
815	0.50	100	0.40	80	100	0.35	87½	70
817	0.20	100	0.20	100	100	0.30	150	150
821	0.20	100	0.40	200	100	0.35	87½	175
City aggregates	$1.27	500	$1.76	791	500	$1.62	489	733
City relatives	100	100	139	158	100	92	98	147

City relative for July on May base computed by averaging and multiplying relatives.......... 155
City relative for July on May base computed by comparing aggregate actual prices............ 128

This table gives the prices of potatoes during the months of May, June, and July, 1913. These prices have already been published by the Bureau of Labor Statistics. The prices were reported to the Bureau by five identical firms in one city—all the identical firms reporting for that city for the three months, May, June, and July.

In the first column is given the firm number. In the second column are given the money prices per peck for potatoes as reported by these five firms. In the third column the money prices are reduced to percentages or relative prices, May being taken as the base. Of course, all relative prices for that month are represented by 100. In the fourth column are given the June prices per peck for potatoes reported by these same five firms. In the fifth column are given the relative prices in June on the May base, that is, the percentage of June

o May prices. You will notice that some of the prices
d to the Bureau look very peculiar. Firm 808 reports
s at 17 cents a peck in May. Firm 815 reports potatoes
peck at 50 cents in May. Clearly here we are dealing
fferent economic commodities. No doubt, 17 cents is
e for old potatoes, while 50 cents is the price for new
s. Note the phenomenal changes in prices in June as
ed with May. The first firm shows an increase of 100
t. in the price of potatoes; the second firm shows an
e of 111 per cent.; and the third firm shows a decrease
r cent. Now I wish to emphasize that these prices are
prices reported to the Bureau by all of the identical
one city that reported for the three months under
ration. We instruct our retail grocers to report new
s only when the sales of new potatoes make up more
per cent. of their total sales of potatoes. In this case
as if some of the firms had not strictly followed in-
ns, but I have as yet discovered no way of going behind
ection returns." We must rely upon the honesty and
nce of the firms reporting. Had the prices reported
815 been called to my attention early enough, I
have eliminated it altogether—at least the price
l for May.

let us consider the city relative price constructed by
g the individual firm relatives for the month of June.
ple arithmetic average of the relatives in column 5 is
t is, according to the information given by this relative
rices of potatoes in this city have risen 58 per cent.
ay to June. By comparing the aggregate money
e get quite a different result. The aggregate prices
used in the construction of relative prices in this case,
the firms reporting are identical for the months of
d June. Of course, if a different number of firms had
l in May as compared with June, it would be necessary
o compare identical firms or to reduce the aggregate
o average prices before anything like an accurate
ould be obtained. The aggregate money prices in
e $1.27. The aggregate for June is $1.76. Reducing
ese money prices to percentages of the May price by

dividing by $1.27, we obtain as the June relative price
May base, 139. This is almost 20 points less than th
relative price obtained by averaging individual firm rela
a difference which certainly is not negligible and w
altogether due to the difference in method of calculati
relative prices.

Whatever may be said of the excellences of a general
price constructed by the method of averaging relative
built up from different bases for the purpose of showing c
in the cost of living, a relative price built up from
money prices shows much more accurately what we w
show, namely, changes in the cost of living—changes
cost of the same quantity of a commodity or of an un
market basket.

Since 1907 the method followed by the Bureau i
structing relative retail prices and index numbers has
follows: Identical firms were compared month by mon
theory being that it is inaccurate to compare changes in
prices of five firms one month, eight firms the fo
month, and ten firms the next month. In this way a
price for February would be constructed on the Janua
by comparing the identical firms reporting both for J
and February. Then this February relative price
January base was multiplied into the January relativ
on the base chosen for all relative prices and index n
published by the Bureau, namely, the period 1890–99.
a March relative price was constructed on the Februa
by comparing the prices of identical firms reporting fo
two months. This March relative in turn was mu
into the February relative price constructed on the 1
base. In this way only identical firms were brought int
parison month by month. Now this method of bringi
comparison only identical firms is a perfectly good and a
method, if properly applied, but applying it in this v
cessitated shifting the base of the old index numbe
month. A relative price or index number built up
method of averaging relative prices constructed on d
bases cannot be shifted without a percentage of error tl
only be guessed at. Every time the old index was shi

y described above error was injected into the result, error was perpetuated and probably cumulated month th and year by year. I will refer to this source of little later on.

ying the method of comparing identical firms month th to the figures in the table before us, we obtain an relative price of 98 for July on the June base, for the tical firms reporting in both June and July. By comhe aggregate money prices reported by the five identical e get the July relative price, 92, on the June base.

lumn 9 are given the July relative prices constructed on the May base. The average of these relative prices By the method of shifting from one base to another a very different result. Multiplying the average relice for July on the June base (98) by the average price of June on the May base (158) we obtain what to be the July average relative price on the May base The difference between these two averages of relative r July on the May base is 8 points. In the first case prices are compared directly with the May prices. econd case the July relative price on the June base is ed into the June relative price on the May base. This ne idea of the possible discrepancies which may arise ng the method of comparing identical firms month by even when there is no change in firms whatsoever.

we compare the aggregate money prices reported by firms in June and July, we obtain a July relative 92 on the June base. Now this relative price can be *ithout error* to the May base or any base desired. This best shown by the following simple arithmetical : $\frac{\$1.76 = \text{June aggregate price}}{\$1.27 = \text{May aggregate price}}$ = the June relative price May base. $\frac{\$1.62 = \text{July aggregate price}}{\$1.76 = \text{June aggregate price}}$ = the July price on the June base. Multiplying the July relae on the June base by the June relative price on the e, we have $\frac{\$1.62}{\$1.76} \times \frac{\$1.76}{\$1.27} = \frac{\$1.62}{\$1.27} = 127\frac{71}{127}$, the July relae on the May base, which is exactly the same result

as would be obtained by dividing the July aggregate in the first instance by the May aggregate. Even with changing firms and commodities varying in quality, the relative prices calculated by comparing actual prices may be shifted to any desired base by the method illustrated above with the closest possible approach to absolute accuracy. Shiftability is an indispensable quality in a relative price which must be built up by computing the relative for each month with the preceding month as the base and then shifting the resulting relative price to the selected base period by multiplying through by the relative price for the preceding month computed on the selected base period. If there were no other reason for changing the method of computation, this alone would seem to make the proposed change in method imperative.

The July relative price of potatoes on the May base computed by the old method employed by the Bureau is 155. The relative price of potatoes for the same month on the same base computed by the new method is 128. The difference is 27 points—a difference so great as to shake one's faith in relative prices and index numbers, if we had nothing to indicate to us whether the relative 155 was better or worse than the relative 128. In fact, however, a relative computed from actual money prices does reflect as accurately as possible the percentage changes in the cost of a given commodity. The relative 128 is, therefore, more trustworthy and exact than the relative 155.

In the same way a weighted index number of the family food budget, constructed by the use of actual money prices weighted according to the quantities of each commodity entering into consumption, is much more accurate and trustworthy than either an unweighted or a weighted index number constructed by the old method of averaging averages of relative prices to the fourth and fifth degree.

The advantage of constructing relative prices and index numbers which can be shifted to any base desired has still another important aspect. People are curious to know the percentage of price change from 1912 to 1913 or from 1907 to 1913, or for some other recent period of time. Few are interested to know by how large a per cent. the prices of 1913

he prices of a period as remote as 1890–99. It is le by means of the old series of relative prices and mbers to calculate accurately the percentage change from 1912 to 1913. For example, from the Bureau's 140, p. 16, we learn that the relative prices of round re 174.3 and 199.5, respectively for 1912 and 1913. can from these figures calculate the percentage of n the prices of round steak from 1912 to 1913. The critics of the Bureau's price statistics almost invariably the percentage of change by the short and simple of subtraction, contenting themselves with the mision that the price of round steak rose 25.2 per cent. 2 to 1913. A more "scientific" method employed is both relative prices through by the 1912 relative, ereby going through the motions of shifting the base 1912, and obtaining 100 and 114.5 as the relative round steak for 1912 and 1913, respectively, computed 912 price as the base. The Bureau has resorted to hod in previous bulletins, to construct tables purporthow the percentage changes in prices from year to his method of procedure is mathematically unsound result is vitiated by an amount of error that can be ed only by digging up the original price data and reting the relative prices anew on the 1912 base. That ble error is no negligible quantity is demonstrated by nsideration of the table below:

PRICES OF POTATOES FOR JUNE AND MAY, 1912.

Firm.	June.		May.	
	Price.	Relative.	Price.	Relative.
904	$0.40	100	$0.20	50
[illegible]	0.36	100	0.17	47
812	0.40	100	0.50	125
817	0.20	100	0.20	100
[illegible]	0.40	100	0.20	50
....	$1.76	500	$1.27	372
....	100	100	72	74
btained by shifting (100 ÷ 158)..	....	....	....	63

elative price for June on the May base computed by g relative prices is 158. This quantity is supposed to

give the percentage relation that June prices bear to
prices. It is desired to find what is the percentage of
prices to June prices. Using the usual method of di
through by the relative price (158) of the period to be u
the new base, we get the following relatives: June 100
63. When we compare the money prices and calcula
firm relative prices and average them we get 74, as
above.

The relative price computed from the original price
tions is more than 17 per cent greater than the relative
obtained by shifting the base in the manner described

It must not be forgotten that the figures used are
prices returned to the Bureau by all the identical
reporting from *one* city. This is not a case cooked up f
purpose of showing a theoretical possibility that conta
element of probability. I chose potatoes deliberately b
their prices behaved so oddly at just this period whe
potatoes are coming in and old potatoes are going out.
example given is extreme, but it is by no means unusu
such capricious fluctuations are repeated every year fo
toes, and to a lesser extent for eggs and some other comm
that are subject to rather violent price changes. No
more startling examples could have been found by
little search. These examples are cited to show typica
changes in a commodity that fluctuates capriciously in
not to exhibit the most extreme cases of such capricious

The relative price computed from aggregate actual
can be shifted at will to any base without error.
evident when we consider the nature of such a relative
The June relative price computed on the May price as
$\frac{\$1.76}{1.27}$. Shifting this series to the June base by dividing
June relative price gives the following: May relative
$\frac{\$1.27}{1.76}$, June relative price 100. Individual commodity r
prices can thus be shifted to the base price of any peri
sired without error because the relative prices are
ratios of actual aggregate prices. Dividing through
relative price of any year or period merely has the ef

uting the aggregate actual price for the base period as in the formula for computing the relative price.

he old method of computation, errors in price data were y perpetuated but cumulated by means of the vicious of averaging, to the fourth and fifth degree, averages ives calculated from different prices as bases and by more unallowable process of shifting every month the the relative prices, which could not be done without ng the relative prices to grave suspicion as a dependable of representing accurately what was happening to These inaccuracies, taken with the inflexibility of prices and indexes calculated by averaging relatives, he changes in methods of calculation which have been out imperatively necessary.

COÖPERATION OF FEDERAL BUREAUS WIT[H] [PRI]VATE AGENCIES IN STATISTICAL WORK

BY JOHN CUMMINGS, PH.D., *Expert Special Agent of the Bure[au of] the Census.*

Members of the associations may be interested in an i[nstance] of coöperative statistical work in which the coöp[erating] agencies included two federal bureaus, two private asso[ciations] or foundations, and a local public agency—these be[ing the] coöperating agencies in a recently completed survey [of in]dustries and schools in the city of Richmond, Virgini[a. The] report of this survey will shortly issue as an official pub[lication] of the federal government. Specifically, the coöp[erating] agencies in this work were the following:

1. The National Society for the Promotion of In[dustrial] Education, which was active in organizing the surv[ey and] assumed certain expenses for printing bulletins bearin[g on] the work and for services of its office force. This soci[ety] just recently, some three weeks since (Dec. 9–12, 191[4) held] its annual convention in Richmond, practically the [entire] time of the convention being devoted to a consideratio[n of the] results of the survey and to the formulation of recom[menda]tions based upon the findings.

It may be noted as an indication of the value of suc[h work] that the superintendent of the Richmond schools state[d at the] convention that the survey had outlined a program o[f proce]dure in industrial education providing for the develop[ment in] Richmond during the next ten years. Incidentally he [stated] that the survey had already saved the city $250,000.

2. The city of Richmond itself, represented by the [Super]intendent of Schools and by a local committee of c[itizens of] Richmond provided funds to cover the cost of making a [survey] of its industries.

3. The Russell Sage Foundation of New York City, [which] through its Educational Director made the school surv[ey, also] assumed a large portion of the cost of the school survey.

* Paper presented at a joint meeting of the American Economic Association and the Ame[rican Statis]tical Association, Princeton, N. J., December 30, 1914.

United States Bureau of Education, represented by
in industrial education, who assisted in the estab-
f prevocational and vocational courses, organised
basis of the survey findings and recommendations.
United States Bureau of Labor Statistics. This
xpert on industrial education was given six months'
bsence, to enable him to serve as Director of the
Survey. The Bureau of Labor Statistics, also, is
e full report of the findings and recommendations,
probably run to 300 pages or more and will include
rge text-charts, a few copies of which, by the cour-
e Bureau, I have been permitted to bring to this
r distribution in case any members present care to
. The Bureau, by assuming the cost of printing
s and the full report, has made possible the publi-
oth the charts and the report in the proposed form.
editor of the Bureau, Mr. Verrill, has served upon
al committee of the survey and through him and
ner Meeker the Bureau has coöperated to the full
s authority to do so.
department of the federal government may be
as being implicated indirectly in the undertaking—
ment of Commerce—since Secretary Redfield of
tment is President of the National Society for the
of Industrial Education. The Commissioner of
istics and the Secretary of Commerce manifested
st in the work by attending the convention held in
to consider the findings of the survey and by
g in the proceedings.
e of interest to note, also, since there has been some
anding as regards the attitude of organized labor
nce to the institution of industrial education even in
chools, that in the work of gathering the data the
e survey had the full coöperation of the local labor
l that Mr. Gompers, President of the American
of Labor, also attended the convention in Richmond
ddress heartily endorsed the proposed program.
acter of the data gathered relating to occupations
erred from the charts, which present in parallel

columns a statistical analysis of some 56 occupatio printing, building, and metal trades, and in the to dustry. Occupations in retail stores are include report, but have not been charted. The report also, the full analysis of each occupation briefly su on the charts, together with a very considerable a tabular matter and general text dealing with the character of Richmond.

The data for the charts and for the tabulations were upon schedules and through personal interviews ployers and employees.

The schedule inquiries related to such topics wages, seasonal fluctuation, age of entrance to trad to which the trade could be learned in the shop, years to learn the trade, age period of maximum productivi of labor supply, the demand for labor and whether th is increasing or decreasing in Richmond; the conditio ployment that involve physical or nervous strain, th late or that narrow or restrict development, or are respects important as affecting the welfare of the w requirements as regards general, trade, and technical of the worker; the line of promotion in the shop; made in the shop for systematic instruction of appre of journeymen; the common deficiencies of work training the school ought to give the boy or girl enters the shop; what it ought to give for the apprenti the journeyman in the shop, by means of continuatio and other facts of importance in constituting a basis for organizing industrial education.

The charts summarize briefly a portion of the data on these schedules and from other sources. In th each occupation shown, the analysis begins with a scription of the nature of the occupation itself and down the column covering the points which have be fied.

Consistently with the purpose of the industrial surv to provide a basis of statistical information relating trial occupations in the city of Richmond upon whic a system of industrial education in the public scho

work was still in progress, courses were organized, e to requests coming from the workers themselves, s, plumbers, electricians and for workers in other s.

umed as a principle justifying such surveys that education must be intimately related to specific trial needs—that it must be based upon data re- to occupations in general, but to occupations as by the industrial developments of the community at sort of education is undertaken—taking account, e, of the extent to which processes and employments n community have been specialized. In the survey nd's building trades, for example, some fifteen dis- ations could be defined, but if the survey had been rk city, the number of distinct occupations in the ades would have been very much greater. In the carpenter may have occasion infrequently to et floor, in New York, the parquet-floor layer may ired even occasionally to do any other sort of work. the needs of Richmond, as regards industrial educa- cal and peculiar, and the industrial courses estab- chmond should, therefore, be unique, reflecting the character of the community and being modified ped as the local industries change. In accordance principle, the data upon which to base industrial n any community must be gathered in the work- t community. This makes the basis of industrial mpirical and statistical. It makes the problem of ducation essentially a local, municipal problem. that no system of industrial education devised for nity is adapted to the needs of any other commu-

blem of industrial education is so essentially local , what interest has the federal government in the Richmond's industrial education? The answer is bvious. No social problem is purely local, and trial education must, if it is to be efficient, be d locally, it is, nevertheless, in the aggregate a fair. The federal government, representing the

country as a whole in its industrial development and competition with foreign nations, is interested in the extension of practically efficient industrial education as a national asset, just as Richmond, in its industrial development in competition with other cities, is interested in the development of practically efficient industrial education as a municipal asset.

Formal coöperation, such as has been outlined, between public and private agencies in the actual field work of statistical inquiry, may seem somewhat inconsistent, not only with official dignity, but with the general principle that public agencies must not engage in private enterprises. This appearance of inconsistency arises from a failure to recognize that private associations may be engaged in work which is clearly affected with a public interest. Where this is the case coöperative participation of federal bureaus in rendering statistical service is entirely proper as a public function. The extent to which government bureaus can coöperate with private agencies in statistical work is obviously limited to such enterprises as are clearly affected with a public interest, and in general the possibility of coöperation is determined by the character of the private agencies.

The number of responsible, permanent private foundations and associations which represent important social interests is very considerable and is increasing. These private organizations have arisen in response to recognized social needs. Immigrants stranded in our large cities, for example, constitute a social problem, and a League for the Protection of Immigrants is organized. The need for industrial education becomes pressing and a society for the Promotion of Industrial Education is organized. Conservation of soil, water-power, and forests is the basis of private associations. In a word, every important social need is bound, sooner or later, to become the basis of organization. Such organizations are national in character, they represent national interests, and where the purposes of these organizations are consistent with the public interest, coöperative participation by bureaus of the federal government in the work which they are doing, would seem to be a natural procedure.

Incidentally it may be noted that the difficulties in the way

öperation are in some respects less considerable than
se of public agencies. Public agencies, state or
are essentially local—essentially not national in
Every public agency has its geographic field of
defined in ordinances and statutes. Such agencies,
operate under a rigid legal definition of powers and
which in many instances constitutes a barrier to
oöperation.

ase of private agencies there is no rigidity of legal
be broken down. It may be noted, further, as a
n for coöperation with private agencies that they,
ently than public agencies, represent specific social
national in scope—that they represent live interests
e developed in the community—that they represent
community is thinking about; whereas the public
bureau represents a traditional interest as defined
r less permanent statutes and ordinances. The
gency may infuse inspiration and motive into
tine.

vantages of coöperation in the instance which has
will be obvious, and it will, I think, be clear that
eat advantages may result from similar coöperation
nes of work where permanent, responsible, private
e in the field.

ne work on the Richmond survey was done under
on of professional experts, who prepared the sched-
upervised the field work and the tabulation of the
h work, if it is to be of value, must be done by
ls, and it will be obvious that cities generally cannot
orps of experts for this work, since in the nature of
e work is not, as regards any single city, continuous.
the condition which perhaps more than any other
peration of the federal government essential. A
cy undertaking such work independently may
ssary to depend upon inexperienced service. With-
ation, each survey is experimental and the data
elating to occupations and industries in different
ound to be of varying value and character.

As regards the country as a whole, however, assuming that cities generally undertake such surveys, the work is continuous, and bureaus of the federal government can, therefore, organize on a permanent basis for the promotion of such undertakings.

While the statistical analysis of occupations undertaken in Richmond was undertaken for the specific purpose of providing a basis of industrial education in that city, the data gathered are of general economic significance, being such as must to a greater or less extent underlie economic speculation regarding industrial conditions and employments. The significance of the data will, obviously, increase in proportion as the number of cities covered increases, and in proportion as the work is organized and conducted in accordance with some uniform scheme. Coöperation of the federal bureaus would seem to be an obvious way of securing this uniformity in method and data.

Finally, it is of importance that the schedules used in such work shall be subjected to scientific criticism and that they shall be perfected so as to get the data which are of economic value. The Richmond survey is the first of its kind and is necessarily in this respect experimental. It is intended to serve as a type survey, but even while the work was in progress those engaged in the work realized that improvements could be made in the methods and in the schedules, and when the report issues from the Bureau of Labor Statistics, it is to be hoped that criticisms will be freely forthcoming from those interested to secure accurate data regarding the common industrial pursuits of wage-earners.

PRESENT STATISTICAL NEEDS AND THE TATISTICAL WORK OF THE FEDERAL GOVERNMENT.*

GIFFORD, *Statistician, American Telephone and Telegraph Co.*

to speak on the subject of Some Present Statistical d the Statistical Work of the Federal Government. n *present* statistical needs merely to remind you that only possibly but probably a fact that the statistical today differ somewhat from those of a not far-esterday.

ne is too limited to bring evidence to prove this point, tory of changed conditions of industry and the growth undertakings in business and social fields, with the increased necessity for up-to-date statistics, has often told that it does not need repeating. The Reserve Board, the new Industrial Trade Commission, United States Commission on Industrial Relations ices of new federal bodies that will have to rely largely istics in their work. The private organizations and and large business undertakings which must so becoming almost innumerable. These recent devel-mean that the field of the economist and the statis-s been extended and that work somewhat similar reviously done by the academic economist or statis-now being done as a practical every-day affair by no means exclusively specialists in economics or

hen does the present statistical work of the federal ent meet these rather new requirements? As in the still have the academic requirements and the needs ecialist and student. That the statistical work of the government largely meets these academic require-here seems to be little or no question. While it is a degree in meeting the newer practical require-

*fore the American Economic Association and the American Statistical Association, at J., December 30, 1914.

ments, these requirements are so important that they deserve careful consideration.

In the first place, when information on a given subject is desired, it is essential to know promptly just what is already available without the necessity of too much specialized knowledge of all possible sources, as to just how much along the lines in question has already been done. Otherwise, much time and expense may be wasted in duplicating information already collected or, what is still more serious, important decisions may be made more or less by guess, which decisions might have been based on facts already compiled. To find out what the federal government with its many departments and diversified interests has to supply in the way of statistics is, at present, to the ordinary busy man a complicated and difficult task. This statement may seem strange to the specialist who has become thoroughly acquainted with the duties and work of the federal government and with the various sources of information which there are at present regarding that work.

What I plead for, however, is a subject index which could be published from time to time, furnishing a convenient source of information for all the statistical data available in the various departments of the federal government. This should, of course, be kept up-to-date, by, say, monthly bulletins and periodical revisions of the complete index.

Parenthetically, I cannot pass this thought by without suggesting that a subject index of statistical information, available not only in the federal government but in state, municipal, and private fields, although it would be a colossal undertaking, would in its results more than justify its expense.

As I said before, many people today use statistical information who are not students or specialists. Now this idea presents another need. These are busy people in their particular work, whatever it may be; they look in a document for certain figures and they do not always read the text which explains those figures. It is, therefore, important to prevent serious mistakes that all tabular statements of figures should be self-explanatory; *i. e.*, the limits of the use of the figures in the table should be shown by either the heading of the table or a footnote. If absolutely necessary, the footnote could

ertain pages of the text with a statement that the
ould not be used for any purposes without first
ad the text.

he question of speed is important, for figures become
ble for many purposes in direct proportion to the
s of the date of which they are representative.
st, with only the essential text issued promptly, and
analyses issued later might well be the standard

I would say a word about the adaptation of the
atistics prepared to the kind of statistics needed.
which can be done to further improve the direct
etween the men who use the statistics and the gov-
epartment which collects them would be decidedly
le. We are discovering every day that we want sta-
a sort which we have not yet gathered. It is,
re, possible that we are gathering statistics of a
we no longer need. If there were formed a stand-
ttee or, better still, an official commission of some
epresentatives of such associations as the American
Association and the American Statistical Associa-
her with, let us say, the American Bankers Asso-
e Chamber of Commerce of the United States, etc.,
entatives of the government statistical departments,
e to the advantage of us all. It would provide a
portunity for us to present such statistical needs
n individual experience develops to a body which
able to take some practical action in the matter.
ct that a great deal has been done and is being done
e various lines but perhaps still more can be done to
m along to a satisfactory conclusion. There can be no
s to the need of having them ultimately worked out.
then, present statistical needs require of the federal
t:

oject index of all statistical data available.
stical tables that are self-explanatory.
test practical speed.
e organization, composed of government and private
s, to assist in adapting the kind of statistics gathered
d of statistics needed.

CONCERNING UNIFORM INTERNATION FINANCIAL STATEMENTS.*

By Harvey S. Chase, S. B., C. P. A., Boston, Mass., and W D. C.

Mr. Chairman and Members of the Associations:— to comply closely with the excellent rule of your r committee which restricts the time allowed to each at this discussion, I must present at once certain co which I have reached upon the topic of this discus leave for another time the explanations of why an was led to these conclusions.

The suggestion embodied in the title of this address me from Dr. S. N. D. North of the Carnegie Endow International Peace and I have been permitted by D to see the correspondence with officials of the "Inte Statistical Institute," whose permanent headquarte The Hague and whose last international meeting wa Vienna in August, 1913. This correspondence has i possible working coöperation between the Carnegie ment and a Committee of the International Statisti tute, or other eminent statisticians, for the purpos veloping a plan for the compilation of uniform inte financial statistics; in other words, to establish what has long needed, a basis for an international budget

The Institute officials, particularly Dr. Zahn of Mun been interested for years—even so far back as 1853- tions relating to standard schedules for uniform statements by all nations. Much hard work and thinking has been done by Dr. Zahn and others *forma* drafts for such schedules.

It is evident, however, to me, after some fiftee experience in establishing uniform financial staten municipalities, for states, and for the national governm these preliminary drafts have been somewhat too a

* Remarks before the American Economic Association and the American Statistical Princeton, N. J., December 30, 1914

extended and detailed, for the immediate practical
It seems to me that it is necessary, if results are
ined which will justify the labor and expense involved,
ation should be concentrated at first upon relatively
damental classifications, leaving others—even the
ls of these fundamental classes—to be worked out later
tural course of development. By this I mean that
for a perfect theoretical system to be devised, includ-
e detailed subdivisions necessary to embrace the
nts for every nation, we will, owing to the magni-
the diversity of purposes, methods, and accounts
ious nations, postpone for years the beginning and
mplishment of our desire, namely: to obtain com-
f governmental costs in those nations.

contrary, if we are content to exhibit only large,
tal functions in our first classification, we may reach
results almost immediately, and thereafter we may
and reclassify these results according to the increase
owledge of the facts and as the awakening interest of
icians of the nation will provide.

urse was the one pursued in municipal affairs in this
First, in 1899, one city—Newton, in Massachu-
pted the socalled "Uniform Classification of Munici-
ditures" which had been prepared by a committee
tional Municipal League. As soon as the annual
that city was published and it became evident
one city had adopted the classification, the latter
practical character. Other cities adopted it of their
on or under supervision of the League's committee
n two years a whole state, Ohio, had applied it to
ies, eighty in number. Then New York adopted
what improved form and Massachusetts followed,
he uniform classification to all her cities and to all
so far as their annual reports to the Commonwealth
erned. The United States Census, Division of
ebt and Taxation, took it up and soon there was
workable and uniform classifications of municipal
res and revenues which were applicable to any and
s throughout the country.

Now, prior to the practical application in Newton, the National Municipal League had been debating the form of standard classification for some years without results, for the reason that no two people could agree, or can agree, upon all of the elements of any detailed classification. Some will favor one location and some another location for the same function or item. The disagreements are without end, the disputants seldom if ever reach a conclusion upon these theoretical details. For example, if we had not immediately tried out the classification at Newton, just as it was, in 1899, it is possible that the various contestants would be discussing yet, whether "Hospitals" should be associated with "Charitable Institutions" or with "Conservation of Health" and whether "Cemeteries" should be classed as sanitary measures or as "Public Utilities." Therefore the important thing is to get the movement started in practice on a simple but fundamental classification, which can be agreed upon promptly by a majority of those who have expert knowledge of the subject.

What appeals to me concerning the present matter-in-hand is this:—That a committee of the Statistical Association or of the Economic Association or, better, of both combined, should be appointed. Not too large a committee, but one whose members can meet conveniently and regularly and thereby accomplish definite results within a relatively short time. This committee should adopt, after proper discussion, a preliminary classification of national functions with such subdivisions as may be deemed practicable and then the new budget of the United States of America for 1915–16 should be drawn up by the committee and published in accordance with these classifications at the earliest possible moment—not a year or two hence but right off now, within two months or three at the outside. Then, the practicability of the classification having been established through adjustments made during this experience, the published results should be spread broadcast in this country and abroad for criticism, suggestion, and imitation. The committee, also, should be authorized to consult and coöperate with foreign committees, which have been, or may be, appointed for the same purpose.

Now, what are the fundamental functions common to all, r nearly all, the nations? Evidently—we have the proof efore us—"War," or "National Defense," is one of them; he most important single function of them apparently. What is another? Evidently national "indebtedness" is nother; to wit:-debts, sinking funds, interest, all matters elating to national debts, funded or floating. Again, national administration" is universal in some form. The legislative, xecutive, and judicial functions are everywhere present. They can be classified without serious difficulty; by this I nean the higher administration, the "overhead" costs of ational government.

So far we have mentioned three large, fundamental funcions, national defense, national indebtedness, and national dministration, each capable of simple subdivisions of uniform nd standard character. With these three we shall have covred much more than half, probably three quarters, or even nore, of the total costs of each national government. We may vell be satisfied with these three if it should prove impracicable to advance further this year. I am convinced, however, that we shall find that we can advance quite a little urther almost immediately. For instance, there are the "pubic service" or "public utility" functions, such as railroads, elegraphs, telephones, mail service, and express service. Also there is forest service, and agriculture, as well as commerce, and various other functions which can be classiied, in big subdivisions at least, and which will be fairly comparable among the nations. Soon, however, we would get into serious difficulties and would be obliged to stop, for the present.

"To stop" reminds me that my time is expiring and therefore I desire to suggest to you the advisability of the appointment of a joint committee, such as has been outlined, to consist of, say, six persons, one-half from each Association. This committee should be instructed to take hold immediately of our subject and prepare the fundamental classifications promptly. If such a committee does its work effectively, the results should be of great importance and the work should be a means of gratification to the members of both of your learned bodies in the future.

APPENDIX.

EXHIBIT OF ONE SIDE OF THE NATIONAL BUDGET, THE "EXPENDITURE" SIDE ONLY; NOT INCLUDING THE "REVENUE" SIDE.

Prepared by Harvey S. Chase, C. P. A., from the "Book of Estimates" of each year, which is published by the Treasury Department, U. S. A.

UNITED STATES OF AMERICA.

The National Budget on the Expenditure side, Based upon the "Estimates" submitted to Congress by the Departments and Offices for the Current Fiscal Year ending June 30, 1915, and for the New Fiscal Year ending June 30, 1916.

Classified by Purposes of Expenditure (Functions of Government).

GENERAL SUMMARY. TOTAL ESTIMATES.

	Fiscal Year 1914–15.			Fiscal Year 1915–16.		
	Operation and maintenance expenses.	Construction and improvement outlays.	Total estimated expenditures.	Operation and maintenance expenses.	Construction and improvement outlays.	Total estimated expenditures.
A. Totals for "War" Functions (National Defense) excluding sinking-fund estimates	$409,286,834	$56,896,356	$466,183,190	$397,204,573	$61,867,230	$459,071,803
B. Totals for "Peace" Functions (Social and Economic) excluding Postal and sinking-fund estimates	110,074,651	79,239,444	189,314,095	123,806,137	72,500,120	196,306,257
C. Totals for Postal Service	308,803,117		308,803,117	299,175,859		299,175,859
D. Totals for General Governmental Functions	61,839,638	6,698,084	68,537,722	59,760,946	2,413,025	62,173,971
E. Totals for Local Governmental Functions	11,547,132	3,580,521	15,127,653	10,751,495	2,572,759	13,324,254
Grand Totals, all purposes, except sinking-fund	$901,551,372	$146,413,405	$1,047,964,777	$890,699,010	$139,353,124	$1,030,052,134
"Sinking-fund" estimates, having no validity*	$60,717,000		$60,717,000	$60,723,000		$60,723,000
Grand Totals, per "Book of Estimates"	$962,268,372	$146,413,405	$1,108,681,777	$951,422,010	$139,353,124	$1,090,775,134

	Operation and maintenance expenses.	Construction and improvement outlays	Total estimated expenditures.	Operation and maintenance expenses.	Construction and improvement outlays.	Total estimated expenditures.
ESTIMATES FOR COSTS OF PRESENT-DAY NATIONAL DEFENSE						
Current Charges. Annual Appropriations (1)						
Defense by land (Military)	$100,249,712	$14,579,198	$114,828,910	$93,447,100	$15,943,824	$109,390,924
Administration Secretary of War	148,040		148,040	146,440		146,440
Adjutant-General's Office	780,570		780,570	724,870		724,870
Quartermaster Corps	378,670		378,670	376,620		376,620
Engineers and Insular affairs	208,591		208,581	206,290		206,290
Other offices, War Dept	456,598		456,598	453,378		453,378
Defense by sea (Naval)	98,311,306	42,490,734	140,802,040	96,558,480	45,032,801	141,591,281
Administration Secretary of the Navy	76,460		76,460	88,590		88,590
Bureaus Navigation, Intelligence, Records	108,790		108,790	110,790		110,790
Bureaus Engineering, Repairs, Yards and Docks	106,430		106,430	128,430		128,430
Bureaus. Supplies, Accounts and other offices	304,660		304,660	273,740		273,740
Operation and maintenance (2) of the State, War and Navy Building (3)	188,013	2,000	190,013	105,227	8,000	113,227
Totals for current national defense	$201,267,830	$56,871,932	$258,139,762	$192,615,445	$61,284,625	$253,900,070
ESTIMATES FOR COSTS AT PRESENT OF PREVIOUS WARS						
Current Charges. Annual Appropriations.						
War pensions, retirements, veterans' homes, etc.	186,674,527	23,434	186,697,961	183,419,651	582,605	184,002,256
Totals for current charges, war functions	$387,942,357	$56,895,356	$444,837,713	$376,035,096	$61,867,230	$437,902,326
Fixed Charges. Permanent Appropriations. (1)						
Interest on war debts	13,000,000		13,000,000	13,000,000		13,000,000
Sinking-fund provisions for war debts (3)	37,000,000		37,000,000	37,000,000		37,000,000
Trust funds, established by war requirements	2,770,000		2,770,000	2,730,000		2,730,000
Special funds and accts. for war purposes	5,574,477		5,574,477	5,439,477		5,439,477
Grand Total for "War" Functions	$446,286,834	$56,895,356	$503,182,190	$434,204,573	$61,867,230	$496,071,803
Deduct "sinking-fund" (3)	37,000,000		37,000,000	37,000,000		37,000,000
TOTAL ESTIMATES FOR ACTUAL "WAR" FUNCTIONS	$409,286,834	$56,895,356	$466,182,190	$397,204,573	$61,867,230	$459,071,803

(1) These terms "annual" and "permanent" might be better stated "current" and "recurrent," as all appropriations are enacted annually by Congress, even though the amount is not fixed (indefinite) or the time is not fixed (indeterminate).

(2) Operation and maintenance expenses of office buildings, rents, etc., are mainly included in item "operation and maintenance of public buildings" General Governmental Purposes because these expenses cannot be separated under present methods of bookkeeping.

(3) Sinking fund provisions are negligible, merely bookkeeping items having no actual existence. There are no securities and no cash in the so-called "sinking-fund."

(4) See also estimates under "permanent appropriations."

(5) Including Bureau of Naturalization $250,000 in 1914–15, and $307,950 in 1915–16.

(6) This amount should be distributed in detail to the various departments and divisions.

(7) Approximately one-half of this is offset by District of Columbia revenues.

(8) Panama Canal is included in "Peace" estimates although a good case can be made out for including it, or a large portion of its cost, under "War" estimates. In both years, however, certain fortification estimates are included under war functions.

B. EXPENDITURES FOR "PEACE." CIVIL, SOCIAL, AND ECONOMIC FUNCTIONS.

STATE, INTERIOR, AGRICULTURE, COMMERCE, LABOR, ETC.

	Fiscal Year 1914-15.			Fiscal Year 1915-16.		
	Operation and maintenance expenses.	Construction and improvement outlays.	Total estimated expenditures.	Operation and maintenance expenses.	Construction and improvement outlays.	Total estimated expenditures.
Current Charges. Annual Appropriations. (1)						
I. Natural Resources, Agriculture, Etc.						
1. Promotion of agriculture (4)	$8,951,617	$47,500	$8,999,117	$10,562,555	$6,750	$10,569,305
2. Promotion of mining, topography, regulation of water power, etc.	2,284,520		2,284,520	2,345,230	3,000	2,348,230
3. Promotion of forestry	5,390,741	477,590	5,868,331	5,386,256	467,000	5,853,256
4. Promotion of fisheries	1,155,730	255,900	1,411,630	1,096,084	203,400	1,299,484
5. Care and utilization of public lands	3,184,920	10,000	3,194,920	3,098,824		3,098,824
6. Meteorological research, weather bureau, etc.	1,667,270	3,000	1,670,270	1,708,750		1,708,750
7. Statistical research, census, etc.	1,709,720		1,709,720	4,342,540		4,342,540
II. Commerce, Banking, Etc.						
1. Regulation of currency, coinage, etc.	5,862,452		5,862,452	6,213,874		6,213,874
2. Promotion and regulation of commerce	3,578,305		3,578,305	3,406,585		3,406,585
3. Regulation of Standards of measurement, etc.	837,175	395,000	1,232,175	781,355	256,000	1,037,355
4. Promotion of transportation: (4)						
Improvements of rivers and harbors	3,197,815	38,286,080	41,483,895	7,721,435	45,665,788	53,387,223
Lighthouses, life saving, roads, surveys, engineering, etc.	12,484,004	2,679,700	15,163,704	12,509,057	2,454,000	14,963,057
Panama Canal (3)	1,546,395	22,228,760	23,775,155	6,429,197	10,512,440	16,941,637
5. Regulation of banking	194,240		194,240	216,740		216,740
6. Regulation of patents and copyrights	1,626,300		1,626,300	1,584,050		1,584,050
III. Welfare, Labor, Etc.						
1. Promotion of public health (4)	4,087,062	104,700	4,191,762	4,425,188		4,425,188
2. Promotion of education and recreation (4)	1,349,376	1,271,014	2,620,390	1,345,792	953,708	2,299,500
3. Promotion of the welfare of the laboring classes and regulation of labor (5)	4,068,250	812,200	4,880,450	3,966,150	332,000	4,368,150
4. Provisions for Indians and wards of the Nation (4)	9,295,715	1,635,400	10,931,115	9,449,013	706,000	10,155,013
5. Provision for defectives, dependents, etc.	1,565,349	455,000	2,020,349	1,466,356	3,000	1,469,356
IV. Foreign Affairs.						
Foreign affairs and relations (4)	3,920,970	477,000	4,397,970	4,539,766	23,044	4,562,810
V. Departmental Administration						
1. Administration; Dep't of State	354,060		354,060	378,580		378,580
2. " " " Interior	634,040		634,040	635,850		635,850
3. " " " Agriculture	765,988		765,988	896,287		896,287
4. " " " Commerce	252,160		252,160	300,220		300,220
5. " " " Labor	183,040		183,040	165,060		165,060
6. Operation and maintenance, (½) State, War and Navy Building (2)	94,007	1,000	95,007	52,613	4,000	56,613
	$80,241,221	$69,139,844	$149,381,065	$95,038,407	$61,640,130	$156,678,537

I. Interest on bonds, other than for war purposes	$9,900,000		$9,900,000	$9,970,000		$9,970,000
II. Sinking-fund provisions for other than war purposes (3)	23,717,000		23,717,000	23,723,000		23,723,000
III. Trust funds provisions for other than war purposes	7,772,730		7,772,730	7,836,500*		7,836,500
IV. Special funds and accounts for "social and economic" functions.—Viz:						
1. Promotion of Agriculture:						
Co-operative agricultural extension work				$1,080,000		$1,080,000
Reclamation of arid lands		$9,000,000	$9,000,000		$9,000,000	9,000,000
Colleges of agriculture and mechanic arts	$2,500,000		2,500,000	2,500,000		2,500,000
Experiment stations, etc.	48,200		48,200	71,000		71,000
2. Promotion of transportation facilities:						
Operating canals	2,000,000		2,000,000	2,000,000		2,000,000
Protection of navigable streams	2,000,000		2,000,000	100,000		100,000
River and harbor improvements		679,600	679,600	274,600	1,500,000	1,774,600
Roads and trails		420,000	420,000	52,400	360,000	412,400
3. Medium of exchange						
National currency, contingent expenses, etc.	280,000		280,000	280,000		280,000
4. Promotion of public health.						
Meat inspection, Bureau of Animal Industry	3,000,000		3,000,000	3,000,000		3,000,000
5. Promotion of education, recreation, etc.:						
National forest fund	600,000		600,000	600,000		600,000
2, 3 and 5 per cent. funds to States	225,000		225,000	125,000		125,000
Maintenance national parks, etc.	125,000		125,000	100,000		100,000
Public schools, territories	100,000		100,000	95,000		95,000
Education of blind, etc.	11,000		11,000	10,000		10,000
6. Care of Indians						
Civilization of the Sioux	800,000		800,000	600,000		600,000
7. Care of defectives:						
Indigent, Alaska	25,000		25,000	25,000		25,000
8. Foreign affairs:						
Pay of consular officers in transit	65,000		65,000	65,000		65,000
Pay of consular officers, services, vessels, etc.				5,000		5,000
Totals of special funds and accounts	$11,779,200	$10,099,600	$21,878,800	$10,983,000	$10,860,000	$21,843,000
V. Other permanent appropriations for "social and economic" functions	381,500		381,500	176,230		176,230
Totals for Peace Functions (except Postal)	$133,791,651	$79,230,444	$213,031,095	$147,529,137	$72,500,130	$220,029,267
Deduct "sinking-fund" (3)	23,717,000		23,717,000	23,723,000		23,723,000
TOTALS, LESS SINKING-FUND, FOR "PEACE"	$110,074,651	$79,230,444	$189,314,095	$123,806,137	$72,500,130	$196,306,267

* $6,600,000 of this are for Indian trust funds. Other footnotes on p. 457.

C. EXPENDITURES FOR POSTAL PURPOSES.

	Fiscal Year 1914–15.			Fiscal Year 1915–16.		
	Operation and maintenance expenses.	Construction and improvement outlays.	Total estimated expenditures.	Operation and maintenance expenses.	Construction and improvement outlays.	Total estimated expenditures.
ESTIMATES FOR POSTAL SERVICE						
1 Postal service, payable from postal revenues	$306,953,117		$306,953,117	$297,355,164		$297,355,164
2. Administration of Postmaster-General's Dept.	1,850,000		1,850,000	1,820,695		1,820,695
3. Operation and maintenance of post offices, etc. (2)						
TOTALS FOR POSTAL SERVICE (2)	$308,803,117		$308,803,117	$299,175,859		$299,175,859

Covering requirements both for purposes of war and for purposes of peace.

LEGISLATIVE, EXECUTIVE, JUDICIAL, ETC.						
Current Charges, Annual Appropriations (1)						
I. Legislative:						
The United States Senate	$1,849,287	$8,500	$1,857,787	$1,858,217	$5,000	$1,863,217
The House of Representatives	4,956,985		4,956,985	5,090,977		5,090,977
II. Executive:						
The President, Vice President and the executive offices	210,440		210,440	211,840		211,840
Civil Service Commission	450,166	5,000	455,166	466,085		466,085
Collection of the revenues, etc.—Treasury	17,247,650	125,000	17,372,650	17,034,460	50,000	17,084,460
General accounting and auditing—Treasury	1,752,080		1,752,080	1,768,930		1,768,930
Operation and maintenance of public buildings and grounds (2)	8,096,412		8,096,412	7,245,354		7,245,354
Construction and improvement of buildings and grounds		6,302,584	6,302,584		2,130,525	2,130,525
Public printing, all departments (6)	5,892,406	130,000	6,022,406	5,000,885	100,000	5,100,885
General Supply Committee	65,640		65,640	42,090		42,090
Reference and library purposes	465,585	127,000	592,585	364,740	127,500	492,240
Distribution of documents	318,275		318,275	329,765		329,765
Administration of Treasury Dept.	1,890,770		1,890,770	1,796,520		1,796,520
Administration of Dept. of Justice	777,711		777,711	622,148		622,148
Detection of crimes legal advice, etc. (Justice)	2,694,020		2,694,020	2,592,560		2,592,560
III. Judicial:						
The Supreme Court and other courts	6,299,110		6,299,110	6,453,380		6,453,380
Fixed charges—Permanent Appropriations (1)						
Revenue refunds, drawbacks, etc.	8,470,000		8,470,000	8,490,500		8,490,500
Retired judges, Hawaiian judges, etc.	175,500		175,500	175,500		175,500
Revenue Collection, night services	225,000		225,000	200,000		200,000
TOTALS FOR GENERAL GOVERNMENTAL FUNCTIONS	$61,839,038	$6,698,084	$68,537,722	$59,760,946	$2,413,025	$62,173,971

E. EXPENDITURES FOR LOCAL GOVERNMENTAL FUNCTIONS.

Territorial Governments	$304,638		$304,638	$233,800		$233,800
Philippine customs and internal revenue	321,000		321,000	181,000		181,000
District of Columbia (7)	10,911,094	$3,580,521	14,491,615	10,335,695	$2,572,739	12,908,434
Militia, industrial schools, etc.	10,400		10,400			
TOTALS FOR LOCAL GOVERNMENTAL FUNCTIONS	$11,547,132	$3,580,521	$15,127,653	$10,751,495	$2,572,739	$13,324,234

Footnotes on p. 457.

INTERNATIONAL COÖPERATION FOR THE STANDARDIZATION OF STATISTICAL WORK.*

By Roger W. Babson.

As Mr. Chase has so ably suggested, some of us are much interested in certain plans for standardizing and jointly publishing certain international statistics of which statesmen and business men are so much in need. We further believe that the development of the statistical work of the United States Government has reached a point where to longer go ahead without regard to what other nations are doing will mean a lot of undoing later.

In view of the fact that President Koren has given me a place upon this program to tell about this work, I feel that the least I can do is to reciprocate by basing the first half of my remarks upon a most able paper upon the subject which he read last year in New York. Our argument in brief is as follows:—

"For years it has been the hope of statesmen and economists, as well as of statisticians, that the censuses of the principal countries of the world might become so standardized that it will be possible to make accurate comparative studies of the true growth and relative prosperity of the respective nations. It has not been contemplated that the national censuses should follow the same pattern in all details, but that they should deal with specified subjects in a certain uniform manner, such subjects to be chosen as will afford a fact-basis for determining the economic and social standing and development of each nation.

"The possible utility of a world standard of values as applied to nations is infinite. The interdependence of nations in things that make for prosperity and general well-being is daily becoming more obvious. Back of much of the insecurity and strife in international commerce and industry, back of the halting way in which we endeavor to meet common social

*Paper read at the joint meeting of the American Economic Association and the American Statistical Association, Princeton, N. J., December 30, 1914.

problems, back of the international jealousies and suspicions hat always threaten, lurks ignorance of national and inter-national conditions and relations. It is the ability to strike reliable balance sheet that has made possible the huge systems f combinations in commerce and banking. Is not the use of balance sheet equally urgent in the affairs of nations if they hall be directed for the common good of all?

"Of the many by-products to be derived from standardizing nowledge in the manner indicated, how it will point to oppor-unities in business, prevent losses through foreign investments nd commercial dealings, how it may help to a better distri-ution of population as well as products of agriculture and ndustry, how it may reveal fundamentals in educational ystems that make for real prosperity, there is not time to peak."

The idea of a Standard International Census has had many dvocates within bodies like the International Statistical nstitute, and the International Agricultural Institute at ome. Recently, at various gatherings here and abroad and hrough publications, the idea has won new momentum. verywhere it meets hearty approval. Boards of trade, pro-ucers and bankers, no less than statisticians, economists, nd peace advocates, readily see its wide bearings.

Of course, such a development in statistics will not be rought about at once. One feature, however, can be taken p at a time and a beginning made very soon. Mr. Chase has hown the need of standardizing the budgets of the leading ations, and other members of our associations have at times leaded for conformity in other statistical work. One specific lustration is the work being done by Professor Irving Fisher, r standardizing the Commodity Prices Indices of the dif-erent nations. Very important fiscal, industrial, and social novements are absolutely held up for lack of scientific and omparable figures on the cost-of-living.

Mr. Meeker has referred this morning to the great work hich he is doing toward setting our own house in order, and et he is being forced to do this independent of any help from ther nations, which makes it almost certain that some day must all be done over again. The same condition of affairs

exists in connection with our figures on exports, imports, and a host of other subjects. Every conscientious governmental official is up against the same problem that Mr. Meeker is, while the bankers, manufacturers, and merchants of the country are all at sea.

But some say: "Why trouble about so-called international statistics until we get better national statistics? Why try to standardize the statistics of the world until we standardize those of our own country? Why attempt to make England, Germany, and the other great nations conform to the same methods of compilation until we get California, Illinois, and Massachusetts to agree?" At first thought these questions seem reasonable, but there are good answers to them all. First, the very time to standardize such statistics is before they are "perfected" in the different countries. The more incomplete they are, the easier it will be to induce the different nations to adopt the standardized forms. The longer the change is delayed, the more difficult it will be to get them to make the much desired changes. Second, it would be very much easier to perfect the compilation and methods used by the different states of our own country if we had some international standard to refer to. California may not want to change her system to please Massachusetts or to copy a standard set by Illinois, but she could be much more readily induced to adopt some international standard prescribed by an international commission.

Members of the American Statistical Association and members of the American Economic Association: This seems like a large order, but the statistical work of the United States Government, to be of real value, depends upon the placing and the filling of such an order.

But since our last meeting something has happened which may very much help in this development. I refer to the great European war. In closing, I wish to say a word about this development. From reports which I am receiving from Europe, two probabilities are now apparent concerning the war in Europe. One is that the war will be called off before many months with neither side vanquished; and the other is that it may result in some sort of a commercial alliance which will

assure equal protection to the commerce and markets of all nations.

The Hague Tribunal, which has been the work of pacifists and jurists, has signally failed. We have learned that little progress can be made for world peace through sentimental plans for arbitration. We, however, see in the newspapers of the past few days the beginning of another great movement under commercial and shipping interests, which appears very hopeful. This movement, moreover, is even being officially endorsed by the diplomats of our sister republics at the south, and I might add that I leave in two weeks for Chile and Argentina in connection with this work. In fact, the "Neutrality Commission of Nine," recently appointed by the Pan-American Union is a most hopeful sign of the two probabilities to which I refer above—namely: (1) That the war will be short, and (2) that a commercial alliance may be formed which will make another such war very improbable.

If the leading nations come together in a commercial alliance to neutralize the seas, regulate trade-barriers, and assure all member nations equal commercial protection, this will be the beginning of a great development in international statistics. It will lead to standardizing the censuses and all the vital commercial and industrial statistics of the different nations. As the development of the simplest form of national government was dependent on collecting statistics for proportioning representation, taxation, etc., so the development of any international alliance or federation will carry with it the extension and standardization of international statistics.

Did you ever think that political revolutions exist today as in the past, excepting that we make armed fighting unnecessary? Every four years before there is a chance for an armed conflict, we count the conflicting parties and if we see that one side has enough more males to win than the other, we call them the victors from the result of such a count. In other words we let both sides fight; but insist that they fight statistically with ballots, instead of in a mediaeval fashion with bullets. Hence, I believe that not only will this new international movement bring about the much hoped for development of international statistics, but that the wars of the future may be fought with

statistics and ballots instead of with guns and bullets. Certainly, it must be with one of these two classes of weapons, as the world can never remain *in statu quo* as the pacifists so supinely hope. In view of this possible development I conclude as follows:

1. That, granted the existence of certain glaring needs to which President Koren, and Messrs. Willcox, Meeker, Mitchell, Durand, and Gifford have so ably referred, the statistical work of the United States Government has now reached a point where it should at once seek to coöperate with other governments in standardizing the census and statistical work of all nations.

2. That this means the formation of some sort of an official international census office entirely apart from the excellent work of the International Statistical Institute at The Hague.

3. That the duty of the American Statistical Association,—the second oldest statistical association in the world and the only one of any consequence in a now neutral nation—is to call an international conference to consider this project.

4. And finally, that in the meantime, we individual members work and talk in favor of this proposed commercial alliance and the neutrality plan of our South American brothers, for if these are successful, international and national statistics will be put on a plane higher than we have ever yet dared to hope for up to the present time.

THE CENSUS OFFICE IN COMMISSION.*

By S. N. D. North, *Director of the Census, 1903–1909.*

I have read with much interest the article in the *Political ience Quarterly* for September, 1914, by Professor Walter Willcox, in which he gives a summary review of the long uggle maintained by the Director of the United States nsus—from 1903 to 1909—to uphold the independence of t bureau in accordance with the letter and the spirit of law.

As the Director in question, and thus the storm center of movement to destroy the independence of the Census, I ire to add some particulars which Professor Willcox either rlooked or under-emphasized.

The matter is one of vital importance to the future of tistical science in the United States, and the statisticians uld be fully informed as to the facts, in order that they may ermine their duty.

ince I resigned the directorship of the Census in 1909, I e refrained from any public statement on the subject and ided any defence of my own official conduct under cir- nstances which were unusual and trying. Now that an- er has revived the subject, and has reached the conclusion, er an impartial examination of the documentary history, t the position of the Director was "legally impregnable" oughout the whole period, I feel warranted in breaking silence, disregarding the personal aspects of the con- versy, which are of no consequence to the public.

position which was "legally impregnable" at the time, ar from being "still open" as a legislative question, has n determined by subsequent legislation, the significance which is not sufficiently understood. Discussion of the ails of the controversy has become academic; but the slation which was intended to end it, is the law of the d.

paper read at the Annual Meeting of the American Statistical Association, Princeton, N. J., ber 29, 1914.

Professor Willcox has demonstrated that it was the intent of Congress, in passing the act of 1899 for the taking of the Twelfth and subsequent censuses, "to give the Director full control of the Bureau," an intent subsequently confirmed by the Attorney General. The Congress again made clear its intent when it passed the act for the establishment of the Permanent Census Office, which continued all the powers given the Director in the previous act, under which was produced the most satisfactory census ever compiled in this country. That the Congress had no intention of changing a census law which had so abundantly justified itself, when it transferred the Bureau to the newly created Department of Commerce and Labor, is shown in the debates, when this act was under discussion.

That Congress has never since had any such intention is made equally clear by the content of the two bills on the subject which have been passed by Congress since that transfer, the second of which is now the only law for the administration of the Census Office.

The first bill to provide for the Thirteenth and subsequent censuses was under consideration for a number of weeks in the Census committees of both houses. There were numerous hearings by both committees, and the details of the bill were carefully considered. At a hearing of the House Committee there was presented a letter from the Secretary of Commerce and Labor (Hon. Oscar S. Straus), dated January 15, 1908, in which he said:

"It is noted that the [Census] bill as it now stands, with the exception that appointments of certain persons in the Bureau proper shall be approved by the Secretary of Commerce and Labor, and that requests upon other Departments for information pertinent to the work provided for by the act shall be made by the Secretary, confers upon the Director of the Census all the duties of every description in connection with the census work independently of the Secretary of Commerce and Labor. This seems to me inadvisable."

The Secretary then set forth his objections to each specific paragraph conferring independent authority upon the Director, concluding with the statement that "the setting up of a

ureau within an Executive Department which is independent its head, would constitute an administrative anomaly which is believed it is not the purpose of Congress to create." He ged the committee to confirm by direct legislation, all e limitations upon the Director's authority and responsility, which the Secretary of the Department had undertaken establish by executive order or otherwise.

The Secretary was not familiar with the history of census volution, and unaware that the whole question he raised had een decided in 1899, and again in 1903, after a full consideraon. His letter was the first formal statement of the attitude the Department on the issue it raised. After careful conderation of this letter, the committee voted unanimously gainst amending the bill as requested. It was reported to the ouse in its original form; it was there debated at length; no mendment was proposed embodying any of these proposals f the Department, and it was passed without dissent. The ame thing happened in the Senate committee, and in the enate itself.

In order to make the intent of Congress unmistakable, and o negative, once for all, the contention that by reason of the ransfer of the bureau to the Department of Commerce and abor, the independence and power of the Director had een submerged in the authority of the Secretary of the Deartment, section 33 was made to read as follows:

"That the Act entitled 'An Act to provide for taking the 'welfth and subsequent censuses,' approved March third, ighteen hundred and ninety-nine, *and all other laws and parts f laws inconsistent with the provisions of this Act are hereby reealed.*"

It will be recalled that this first bill for the Twelfth Census vas vetoed by President Roosevelt. This veto was directed gainst two provisions of the bill: one relating to the method f appointment of the extra clerks to be employed and the ther (upon which little stress was laid), permitting the Diector to go outside the Government Printing Office, if he hought desirable, to secure the prompt publication of the Census reports. The provision of the bill relating to the appointment of the clerks authorized "non-competitive" exam-

inations, and grew out of the desire of Congressmen to have a hand in the appointment of these clerks without the restraint of the Civil Service law.

When the President sent for me to inform me of his intention to veto the bill, because of this provision, I pointed out to him that the provision was so clumsily drawn that it would be a simple matter for him to issue an executive order which would avoid the evil he foresaw, viz.: an order directing that appointments must be based upon the actual standing of applicants, as shown by the markings of the Civil Service Commission. He admitted this, but said that he must veto the bill nevertheless. "These people have given me a chance to read them a lesson," he added, "and I am going to do it." He went on to say, what he afterwards repeated in his veto message, that "Outside of these (two) matters, I believe that the bill is, on the whole, satisfactory, and represents an improvement upon previous legislation on the subject." (*Congressional Record.* Vol. 43, Second Session, Sixtieth Congress, p. 1965.) He further said to me that he recognized the fact that the decennial Census was a gigantic undertaking, and the officer in charge of it was entitled to be relieved of all such hampering difficulties as a struggle over spoils.

I record this interview, and quote this message, because they show that President Roosevelt was not in sympathy with the repeated efforts of three successive Secretaries of Commerce and Labor in his cabinet, to emasculate the Census law. He accepted without question every feature of the bill which restored to the Director all the authority and all the independence of which he had been deprived, or of which it was attempted to deprive him, by departmental orders and disingenuous opinions of legal officers.

Congress was reluctant to join issue with the President on the Civil Service issue and the bill went over to the new Congress, in which the personnel of the Census committees in both Houses materially changed. Judge Crumpacker was, however, again the Chairman of the House committee, and he shortly re-introduced the identical Census bill of the previous session, except that it was modified in the two particulars to which President Roosevelt had objected.

gain there were protracted hearings; again the bill passed committee and the House, without opposition on the t at issue, and went to the Senate committee, which called new Secretary of Commerce and Labor as an early witness. lid not reiterate the demands made by his predecessor in previous administration, but contented himself with ng that as the head of the Department of which the Census e was a bureau, he had to ask that the committee would rt a bill which would show beyond any peradventure, just t was to be his official responsibility for the census about e taken. He raised no objection, beyond this question, to bill in the form it had once passed the Senate and twice ed the House.

gain the Senate committee approved the bill, and again Senate passed it; and thus Secretary Nagel's single ques- was answered.

resident Taft signed the bill reënacting the principle of the of 1899; and the practical independence of the Census e was apparently firmly reëstablished.

he significance of this legislation is emphasized by this résumé of its progress through Congress. Everything which I had contended, as essential to the successful ad- stration of a census, was confirmed by legislation now on statute books. The new law removed all administrative tions from the region of doubt and beyond the reach of it writers of departmental "decisions." It was a vic- for the cause of the non-partisan conduct of this great e, and it was won on the merits of the question. The tion is no longer "open," so far as the law is concerned.

ut it has been permitted to remain a barren victory; and ill continue to be, in practical effect, a defeat, unless steps taken to effect the restoration of the Census Office to its l position. I believe the students of conditions and rts in statistics and economics are agreed that otherwise Permanent Census Office will fail to justify its establish- t. It is obvious that this restoration can be effected by a ke of the President's pen.

xperience has already demonstrated that an independent us office, in the true sense of the word, is not possible, so

long as the bureau continues to be subordinate to any of the great departments whose secretaries are cabinet officers, and whose under-officials are at liberty to interfere, in a thousand petty ways, with the conduct of a nominally independent but actually subordinate bureau.

It is not an easy nor pleasant duty for a Bureau Chief to oppose a policy which he knows the head of the Department has close at heart. It is all the more difficult, when personal and social relations are of the pleasantest character. Nevertheless, there was the plain and unmistakable letter of the law, and the oath to faithfully execute that law. When a new secretary arrived—the fifth under whom I served—whose hostile resentment of this attitude was at once apparent, there was no choice but to resign the charge of an office which practically had been put in commission, and which remains there today. From the date of my resignation, the Census Office has been administered in a manner that is openly and indisputably a violation of the letter and the spirit of the Census law.

I have added some details to an interesting and important chapter in our legislative and administrative history. I am unaware of any other instance in that history where a principle of law to govern a great public office, approved by three presidents, and by four Congresses, has been successfully nullified by Departmental order.

What are the lessons to be drawn from this experience? To my mind the fact has been demonstrated that an independent Census Office, subordinate only to the President, is essential to the proper and satisfactory administration of the great statistical factory of the federal government. As Professor Willcox says, it must be a non-partisan and non-political bureau, if its scientific results in many controversial fields of government action are to retain the confidence of the public and of Congress. It is not possible to keep it such, if it is subordinate to any department, the head of which will change with every change of administration. It is the one great bureau which must not be subject to the political mutations so common in the United States.

The unfortunate fact is, in regard to the Census, that its

itical patronage is large, and at times enormous; and this ronage is bound to be utilised for partisan purposes, so long he Director is a part of the political machine, by reason of official subordination to a cabinet officer who is a vital part hat machine.

nother obvious fact growing out of recent experience is t an independent office is necessary to the economical and cient management of the Census Office. The Thirteenth isus cost easily $1,500,000 more than it should have cost. ictly what the expenditure actually has been, it is impossible state; the sum will probably never be known, because the k has dragged on until within the last few months. The required that the Thirteenth Census be completed and lished within two years from the date of the enumeration. ad not been completed at the end of four years from that e; and this in spite of the fact that no census was ever taken his country under conditions even approximately so favor- e. The details of preparation were practically completed ear in advance of the enumeration—that is, the Thirteenth isus had a full year's start over any previous census, and relieved of all the costs of this preparation. This lament- e showing may be attributed very largely, in my judgment, he excessive red tape, the needless circumlocution, and the ndabout methods, which sprang from the reversal of the ninistrative methods prescribed by the law. The director harge was the victim rather than the cause of the conditions forth in the statements made above.

'our years from this winter, legislation for the Fourteenth isus of the United States will be under consideration. It is e too early for the statisticians and economists who are ession here, to take counsel of each other as to what course y can best pursue, under all the conditions, to best promote interests of governmental statistics, and to secure their regation, as a thing apart—their complete separa- 1 from and independence of any and all political in- ests. The facts related in this paper seem to justify the clusion that the plan of an independent bureau, under or hin a department of the government, has proved a failure, l must continue to prove unsatisfactory so long as the head

of the department of which the Census Office is a part, can be permitted to nullify the spirit and purpose of the law. Such controversies as that with which this paper deals are unfortunate, irrespective of the question of who is right and who is wrong. No such conflict can arise, if the office is made independent; and in no other way, this experience teaches, is there a fair chance that it can be kept free from the taint of partisan politics. Never, in my judgment, has the bureau been more completely and notoriously a part of the political machine than is the case today.

PROCEEDINGS OF THE SEVENTY-SIXTH ANNUAL MEETING OF THE AMERICAN STATISTICAL ASSOCIATION, PRINCETON, N. J., DECEMBER 28-31, 1914.

The seventy-sixth annual meeting of the American Statistical Association was held at Princeton, N. J., December 28-31, 1914. The following program was carried out:

PROGRAM.

MONDAY, DECEMBER 28.

8.00 p. m. First Session, 50 McCosh Hall.

Joint session with the American Economic Association and the American Sociological Society.

Presiding officer, Dr. John Grier Hibben, President of Princeton University.

Presidential Addresses:

John H. Gray, President of the American Economic Association, "Economics and the Law."

John Koren, President of the American Statistical Association, "Some Statistical Ideals."

Edward A. Ross, President of the American Sociological Society, "Freedom of Communication and the Struggle for Right."

TUESDAY, DECEMBER 29.

10.00 a. m. Second Session, 30 McCosh Hall.

The Relations of the Association to:

(a) Federal Statistical Bureaus, Frederick L. Hoffman.

(b) State Statistical Bureaus, Robert E. Chaddock, Leonard W. Hatch.

Discussion under the five-minute rule.

2.30 p. m. Third Session, 30 McCosh Hall.

The Relations of the Association to:

(a) Municipal Statistical Bureaus, Edward M. Hartwell.

(b) Public Service and Business Statistics, M. O. Lorenz, Julius H. Parmelee.

(c) Social Statistics and "Surveys," J. L. Gillin.

Discussion under the five-minute rule.

4.30 p. m. Reception at "Prospect" by President and Mrs. Hibben.

8.30 p. m. Smoker at the Nassau Club.

WEDNESDAY, DECEMBER 30.

10.00 a. m. Fourth Session, 10 McCosh Hall.

Round-table meeting with the American Economic Association. Discussion under the ten-minute rule.

The Statistical Work of the United States Government, Wesley Mitchell, Walter S Gifford, Walter F. Willcox, E. Dana Dura Roger W Babson, John Cummings, Harvey S. Chase, Royal Meel
Discussion under the five-minute rule.

2.30 p. m Fifth Session, 30 McCosh Hall.
Improvement and Extension of the Registration Service, Joseph Hill, Louis I. Dublin.
Discussion under the five-minute rule.

7.00 p. m. Subscription Dinner in Proctor Hall of the Graduate College.

THURSDAY, DECEMBER 31.

10 00 a m Sixth Session, 30 McCosh Hall.
Annual Business Meeting.

MINUTES OF THE BUSINESS MEETING.

Meeting called to order by President Koren at 10.15 a.

The reading of the minutes of the previous annual meet was dispensed with owing to the fact that these minutes l already been published in the proceedings.

The Secretary presented the following report:

SECRETARY'S REPORT.

Mr. President and Members of the Association:

I have the following to report in regard to the condition the Association:

Membership February 14, 1914, date of last annual meeting		
New members added		
Deaths during the year	9	
Resignations	28	
Dropped	2	
Total deductions		
Present membership		
Net loss		
Beside members we have:		
Subscribers (mostly libraries)		
Domestic Exchanges		
Foreign Exchanges		
Total mailing list		1,

The death of the following members has been reported dur-
g the year: Honorary members, Archibald Blue, Wilhelm
xis, and Robert Meyer; members, James A. Beaver, Robert
ornan, L. G. Fouse, Charles Fry, Henry Gannett, and J. H.
ngwell.

Four regular numbers of the QUARTERLY PUBLICATIONS
ve been issued during the year, containing an aggregate
349 pages, or an average of 87 pages per number. In
dition to these, a hand-book of 24 pages, containing the
t of members, has just been issued.

The most noteworthy event of the year was the quarterly
eeting and dinner of the Association at the Yale Club, New
ork City, December 11. Fifty-eight members and guests
ere present. The general topic of the evening—"The
tential Value of Statistics in Shaping Rational Public
pinion"—was presented by Henry Bruère, Chamberlain
the City of New York. The following speakers took part
the discussion: N. C. Kingsbury, vice-president of the
merican Telephone and Telegraph Company, on "The
rvice of Statistics to Business"; Carl M. Hansen, secretary
the Workmen's Compensation Bureau Service, on "The
eed of Standardization in Accident Statistics"; Osmond
hillips, editor of the *New York Times*, "Annalist," on
Statistics for Public Consumption"; and F. H. Dixon,
ief statistician of the Bureau of Railway Economics,
ashington, D. C., on "Statistics of Railroads." This was
e of the most interesting and profitable meetings ever
ld by the Association. It was clearly shown by the speakers
at the Association has an ever growing and widening field
usefulness.

Respectfully submitted,

CARROLL W. DOTEN,
Secretary.

On motion, it was voted to accept the report of the Secre-
ary and to authorize its publication in the proceedings in
he March number of the QUARTERLY PUBLICATIONS.

Treasurer's Report.

January 1, 1914, to December 22, 1914.

RECEIPTS.

Membership dues	$1,162.27	
Sales and subscriptions	594.97	
Dividends and interest	113.00	
Balance on hand, January 1, 1914	541.95	
		$2,412.19

EXPENDITURES.

Printing	$1,079.27	
Postage	184.16	
Salaries and clerical service	389.82	
Expenses	17.64	
	$1,670.89	
Balance on hand, December 22, 1914	741.30	
		$2,412.19

ASSETS.

17 shares B. & A. R. R. stock @ 180 per share, $3,060.00.

S. B. Pearmain,
Treasurer.

Auditors' Report.

We have audited the accounts of the treasurer of the American Statistical Association, for the year January 1, 1914, to December 22, 1914, and counted the securities in his possession. We find the accounts accurately stated and the expenditures properly vouched.

Respectfully submitted,

Leroy D. Peavey,
Roswell F. Phelps,
Auditing Committee.

Seventy-Fifth Anniversary Fund.

To December 26, 1914.

RECEIPTS.

Subscriptions	$901.00	
Received from dinner	159.00	
S. B. Pearmain	4.50	
C. W. Doten	7.15	
L. D. Peavey	3.00	
Interest on bank deposit	13.53	
		$1,088.18

EXPENDITURES.

Paid S. B. Pearmain for a check deposited on this account by mistake	$25.00	
Collection charges on checks	1.90	
Algonquin Club	287.40	
Stenographic and clerical work	95.00	
Balance on hand January 1, 1915	678.88	
		$1,088.18

Sumner B. Pearmain,
Treasurer.

Auditors' Report.

We have audited the Convention Fund accounts of the treasurer of the American Statistical Association to December 26, 1915, and find the statements correct and the expenditures properly vouched.

Respectfully submitted,
Leroy D. Peavey,
Roswell F. Phelps,
Auditing Committee.

On motion, duly made and seconded, it was voted to accept the report of the treasurer and report of the auditors, and to publish the same in the proceedings of the meeting.

It was moved and carried that a statement of the Anniversary Fund, held by the treasurer, should be printed in the proceedings of the meeting.

In accordance with the following resolution, adopted by the joint meeting of the American Economic Association and the American Statistical Association:

Resolved, That the American Economic Association and the American Statistical Association, here meeting in joint session, be requested to consider the expediency of appointing coöperating committees on the relations of these Associations to the statistical work of the federal government,

It was voted that the Board of Directors of the Association be empowered to appoint a committee of five, with authority to add to its own numbers, to coöperate with a similar committee of the American Economic Association in considering means of improving the statistical work of the United States government.

The following resolution was presented by I. M. Rubinow:

WHEREAS, the income tax law offers the first opportunity to obtain accurate statistics of incomes in this country, and whereas the present income tax blank is faulty in that it fails to record the profession or occupation of the income taxed, be it

Resolved, That the American Statistical Association request the Bureau of Internal Revenue to include the proper query as to the occupation of the tax payer in the income tax return blank of 1915.

On motion it was voted to refer the foregoing resolution to the committee on Federal Statistics, with power to act.

It was voted, on motion of Mr. Hoffman, that three other committees, similar to the committee on Federal Statistics, to consist each of five members, with power to add to their membership, be appointed by the Board of Directors, as follows:

1. On State Statistical Work.
2. On Municipal Statistical Work.
3. On Business Statistics.

On motion of Mr. Babson, a committee of the same number, to be appointed in the same way, was voted, to be known as the Committee on International Statistics.

It was further voted that each of the committees as above constituted should be authorized to appoint sub-committees from their own members or other members of the Association.

The committees above named have been appointed by the Board of Directors as follows:

Federal Statistics—T. S. Adams, F. L. Hoffman, J. Koren, . W. Hatch, N. I. Stone.

State Statistics—E. Dana Durand, R. E. Chaddock, E. W. Kemmerer, H. J. Harris, Charles F. Gettemy.

Municipal Statistics—LeGrand Powers, L. I. Dublin, E. M. Hartwell, F. A. Cleveland, Fred C. Croxton.

Business Statistics—C. P. Neill, H. S. Person, W. S. Gifford, . M. Rubinow, J. H. Parmelee.

International Statistics—Irving Fisher, Royal Meeker, Harvey S. Chase, M. M. Dawson, R. P. Falkner.

The following resolution was presented by Mr. Miles M. Dawson, and on motion was duly voted:

Whereas, the United States Senate has adopted a resolution calling upon the Commissioner of Labor Statistics to make an investigation of mortality and disability among persons engaged in different occupations:

Whereas, The Commissioner of Labor Statistics has expressed his willingness to perform this work and has asked for a special appropriation of $25,000 to enable him to do so,

Now, therefore, the American Statistical Association urges upon Congress the great importance of securing reliable information concerning mortality and disability among persons engaged in various occupations and the wisdom of making this appropriation to enable such information to be obtained and laid before the Senate.

It was voted to instruct the president of the Association to appoint a nominating committee of not less than three members, and to announce the membership of such committee not less than three months prior to the next annual meeting.

On motion it was voted to leave the time and place of the next annual meeting to be determined by the Board of Directors.

The secretary made a report for the Committee on Constitution and By-Laws, appointed at the last annual meeting of the Association. After some discussion of the draft of the constitution and by-laws presented by the committee, it was voted to refer the matter back to the same committee, and the committee was instructed to report recommendations at a date sufficiently early to permit of action on the same at the next annual meeting of the Association.

The Nominating Committee, consisting of E. M. Hartwel W. S Gifford, and C. W. Doten, reported the following nom nations for office in the Association during the ensuing yea President, E. Dana Durand; Vice-Presidents, Charles I Neill, Charles F. Gettemy, Joseph A. Hill, Edward B. Phelp Charles H. Verrill; Librarian, Horace G. Wadlin; Treasure S. B. Pearmain; Secretary, Carroll W. Doten; Assistan Secretaries, Robert E. Chaddock, M. O. Lorenz; Counsellor Frederick L. Hoffman, Walter F. Willcox, John Kore Editor, William B. Bailey; Associate Editors, Frederick Crum, Louis I. Dublin, Julius H. Parmelee, Warren M. Pe sons; Committee on Finance, Miles M. Dawson, Walter I Weyl, S. B. Pearmain; Committee on Library, Roger V Babson, Edmund E. Day, Horace L. Wheeler; Committ on Nomination of Fellows, Frederick L. Hoffman, Irvi Fisher, Frank H. Dixon, Cressy L. Wilbur, Carroll V Doten.

On motion the report of the Nominating Committee w accepted, and it was voted to instruct the secretary to ca one ballot for the list as presented. This having been don they were duly declared elected.

On motion it was voted that the retiring president appoi a committee of three with himself as chairman, to comple the work of editing and publishing the Memorial volum He appointed as such committee, J. Koren, W. S. Rossit and C. W. Doten.

It was voted to instruct the secretary to express the sinc thanks of the Association to President Hibben of Princet University, and to the various members of the faculty w had by their splendid coöperation provided such excelle opportunities for the meetings of the Association and f the entertainment of its members.

On motion a vote of thanks was extended to the retiri president, for his untiring services on behalf of the Associ tion during the two years of his incumbency.

The meeting adjourned at 11 30

CARROLL W. DOTEN,
Secretary.

REVIEWS AND NOTES.

PROPORTION OF AMERICAN MARRIAGES ENDING IN DIVORCE.

In the December, 1914, issue of this QUARTERLY (p. 310) the following aragraph is found:

> The statement frequently made that in this country 1 marriage in every 2 terminates in a divorce is a serious and inexcusable statistical error. In 910, for illustration, there were 18,098,000 married males in the United tates and only 156,000 divorced males The ratio of divorced men to arried men was, therefore, 1 to 116. The number of married women as 17,688,000, and the number of divorced women 185,000. The ratio f divorced women to the married was, therefore, 1 to 96. The annual ivorce rate per one hundred thousand married population has increased, owever, from 81 in 1870 to 107 in 1880, 148 in 1890, and 200 in 1900. he condition is alarming, but not as serious as frequently assumed.

This subject is of so much importance that it seems best to state briefly he reasons for doubting the validity of the argument quoted and for beeving that the statement criticized is approximately correct. The falacy in the argument lies in its neglecting the fact that the average duraion of married life before death or divorce is many times as great as the verage duration of divorce before death or remarriage. As a consequence f this fact the ratio of divorced men to married men or divorced women to narried women in the community at any moment affords hardly the slightst clue to the proportion of marriages terminating in divorce.

The number of marriages contracted and of divorces decreed in the Unied States during the calendar year 1910, or any other year after 1906, is nknown; but the number in 1910 may be estimated by adding to the numer in 1906 the increase between 1902 and 1906. On this basis there vere in 1910 about 960,000 marriages. The census of that year showed 8,100,000 husbands and 17,700,000 wives, or 1 marriage a year to every 9 husbands and every 18 wives. These figures indicate that the approxinate duration of married life before it ends by death or divorce is 19 years or men and 18 years for women. By a similar argument the number of ivorces granted in 1910 may be estimated from the number granted in 906 plus the increase between 1902 and 1906. If the result, 82,600 divorces, is compared with the number of divorced men and women reported n 1910, it would appear that the approximate duration of a divorce before death or remarriage is for a man 1.9 years and for a woman 2 2 years. Of course these durations are only rough averages, partly because the numer of divorced persons is understated by the census, partly because the increase in the number of marriages year by year would affect the results, and partly for other reasons. But they do show that marriage lasts before death or divorce from eight to nine times as long as divorce lasts before death or remarriage and thus measure the fallacy of inferring from

the ratio between married persons and divorced persons at any moment the ratio of marriages ending in divorce.

The subject is discussed in the Special Report of the Census Bureau on Marriage and Divorce 1867–1906 (pp. 22–24). Several methods are used and the following conclusion is reached:

At the present time the chances are that not less than 1 marriage in every 16 will ultimately be dissolved by divorce and it seems reasonable to suppose that the ratio is nearer 1 in 12.

A simple method of reaching much the same result was stated in a letter by the present writer, printed in the *New York Times* of January 24, 1909, and now slightly revised for republication:

The following figures are taken from the returns for Massachusetts because the death records in that state are probably somewhat more complete than in New York, and Massachusetts comes nearer than any other registration state to the average for the registration area, if not for the whole country.

In the year 1900 married persons to the number of 15,614 died in Massachusetts and 1,260 divorces were granted. Obviously 16,874 marriages were broken by death or divorce, 92.5 per cent. of them by death and 7.5 per cent. by divorce, or about one in thirteen by divorce.

The facts for the ten registration states, including about 26 per cent. of the population of the United States, are similar. In those states there were in 1900 99,601 deaths of married persons and 8,661 divorces granted, a total of 108,262 terminations of marriage, 8.0 per cent. or nearly one in twelve of which were by divorce.

The argument may be extended to include the entire United States in the following manner: In the entire registration area in 1900, including more than one third of the population of the country, the number of living married persons was 10,916,375, and the number of deaths among them was 167,737, or 15.4 per thousand married persons. In the entire United States in 1900 there were about 27,850,000 married persons. If the death rate of married persons in the registration area, 15.4, be applied to this total, the deaths in the country among married persons were 429,000.

The divorces granted in the United States in 1900 were 55,751. Hence the total terminations of marriage in that year were about 484,750, of which 11.5 per cent., or more than one in nine, were by divorce. I am well aware that such a computation involves assumptions, the exact accuracy of which may be challenged, and I am not concerned to prove the perfect trustworthiness of the results. But as a first approximation to the truth, I believe the method is thoroughly sound, and that divorce now terminates not far from one tenth of all the marriages in the United States.

A few months later, at the twelfth session of the International Statistical Institute at Paris,* I examined the same subject before a group of experts and reached the following results:

During the twenty years 1887–1906 there were 64 divorces granted in the United States to each 1000 marriages solemnized, or 72, if we assume that all divorces granted to persons whose place of marriage did not appear on the record were granted to parties married in this country.

By a method applied only to the ten registration states of 1900 in every thousand dissolutions of marriage 80 were by divorce and 920 by death;

* See International Statistical Institute, *Bulletin*, Vol. XVIII, Pt. I, pp. 609–623.

ut after allowing for the fact that the divorce rate in the other states was uch higher than in the registration states, the conclusion was reached that each thousand dissolutions of marriages about 115 were by divorce and e remainder by death.

In view of all the evidence, it appeared that at least 8 out of every 100 arriages contracted in the United States would end in divorce. To this nclusion, however, the following important qualification was added:

> It does not follow that this proportion, or anything like this proportion, tains among those marriages which are celebrated between bachelors and insters. The fallacy involved in such an inference may be illustrated assuming two cases.
>
> 1. Suppose 1,000 marriages between bachelors and spinsters of which 0 are finally broken by death and 80 by divorce, the surviving or divorced rties to these marriages continuing to live as widowed or divorced perns until death.
>
> 2. Suppose 940 marriages between bachelors and spinsters of which 0 are broken by death, the surviving parties in no case marrying again, d 20 are broken by divorce each one of these 40 divorced persons remarryg within that group and being again divorced. Suppose this process to ntinue until each one of the 40 persons has been married and divorced ur times after which no new marriages are contracted.
>
> In both cases we have to deal with 1,000 marriages and 80 divorces but the first case 8.0 per cent. of the 1,000 marriages between bachelors and insters end in divorce and in the second case only 2.1 per cent. of the 940 arriages between bachelors and spinsters end in divorce. It is probable at the average conditions in the United States lie between these two pothetical extremes but where they lie we do not know and cannot tell til trustworthy statistics are obtained regarding the previous marital ndition (single, widowed, divorced) of all parties who enter upon married e. Until such statistics are secured I see no means of answering the vital estion—What proportion of the marriages between bachelors and spinss now end in a divorce?

Walter F. Willcox.

Cornell University.

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e Cancer Problem. William Seaman Bainbridge. The Macmillan Co., New York, 1914. Section III—Statistical Considerations, pp. 70–105.

A statistical chapter written by one who relies mainly upon other methods d uses statistics as a supplementary tool does not arouse high expectans and is not to be measured by exacting standards. With this qualifition in mind, the chapter in the present work entitled "Statistical Conlerations" deserves high commendation. Most of its constructive relts are probable, if not established. The author wisely relies for the ost part upon the work done by Newsholme, Bashford, and especially e English Registrar-General, from which sources he quotes at length. e also shows the lack of any connection between the cancer death rate d overcrowding, the non-existence of "cancer houses," the minor rôle ayed by heredity in the explanation of cancer, the independence of the o diseases, cancer and syphilis, and the error in the common opinion that ws are exempt from the former scourge.

On the crucial question whether cancer is actually increasing or whethe the increase in the death rate from this cause is due partly to a change i the age composition of the population but mainly to improved diagnosi he takes the conservative and safe position that it "has not yet been de cided" (page 104).

On two points perhaps a word of suggestion may be in place. No refer ence is made to a distinction of much importance for the question of in crease, that between cancer as a disease and cancer as a cause of death The author, as a physician and pathologist, may be supposed to be inter ested mainly in cancer as a disease, yet all his statistics relate to cance as a cause of death. To be sure, no other figures exist; but this fact hardl relieves him from the duty of suggesting that what is true of the one ma be far from true of the other, that, for example, cancer as a disease ma be increasing even if cancer as a cause of death is not.

Again, one cannot but regret that a physician and especially an Amer can physician should have spoken so slightingly of American vital statis tics, even though he does it in good company. He returns to this topi several times and in doing so makes the only serious mistakes which I hav noticed. Doubtless American cancer statistics of importance do not ru far back and in many states are still lacking. But the statement that i this country "there are no reliable statistics concerning either the relativ frequency of cancer in the past as compared with the present, or its rel tive frequency in different states, in different towns, or in town as compare with country districts" (page 74) can be defended only by giving the wor "reliable" an emphasis not warranted by the context of the sentenc quoted. The cancer statistics of Massachusetts run back to 1850, those Providence, R I, to 1856, and these figures are probably as "reliable" those of Scotland, Ireland, or Germany. It is not true that Europea vital statistics are reliable in a sense in which American vital statistics a not. The main differences between the two are that American vital sta tistics in this and many other fields cover a shorter period of time and smaller proportion of the population and, more serious still, that, owin to the lack of knowledge of vital statistics among American physician what figures we possess have been comparatively little utilized in th study of such questions as are of interest primarily to physicians.

WALTER F. WILLCOX.

Cornell University.

The Anthracite Coal Combination in the United States, with some account of the Early Development of the Anthracite Industry. By Eliot Jones, Ph.D. David A. Wells Prize for the year 1913–1914. Cambridge: Harvard University Press, 1914.

In this day of trust busting and combination pruning any volume that truthfully relates the origin and growth of such organizations is refreshing. Historically interesting and statistically severe, the volume in question proves its worth by inciting the reader with the desire of a closer acquaintance of the subject in hand. The volume is a comprehensive study of the combination movement in the anthracite coal industry. It sets forth the birth, growth, and final attempt of the government to dissolve the resulting combination. The moving spirits in the combination are the railroads, "owning either directly, or indirectly through subsidiary coal companies, substantially the entire area of the anthracite coal deposits of the United States."

The author roughly divides the history of the industry into four periods: "the first, extending from the middle of the eighteenth century to 1834; the second, from 1834 to 1873; the third, from 1873 to 1898; and the fourth, from 1898 to the present time." Each period developed its own means of transportation. In the last period came the development of the combination which called forth the study.

Although there are other anthracite deposits to be found in the United States, those in Pennsylvania are more fully developed and form the warp about which the author weaves his evidence, historical and statistical. This district is divided into three fields; the Wyoming, the Lehigh, and the Schuylkill. Each field presents its own problems which are vividly set forth. The beginning chapters, truly historical, form an appropriate background from which the remaining chapters, the period of combination, and resultant efforts at pruning, stand forth in bold relief. The characteristic features of the combination development set forth are: first, railroad consolidation; second, the development of a community of interest among the railroads; and third, the practical elimination of the independent operators. The production of coal and its transportation, the price and sale of the same all come in for careful and scientific discussion.

The conclusion of these chapters stated in brief are these: All the anthracite coal mined is controlled by certain railroads; these roads are working in harmony in the fixing of rates and prices. This condition calls forth a chapter on the Legal Status of the Combination in which the author presents the numerous attempts made to dissolve it; the final conclusion being that the problem of public ownership of the natural resources of the country versus private ownership under public regulation is still to be solved. As yet the United States have no definite policy. Until such a policy is adopted, a permanent solution of the anthracite coal problem is not to be expected.

New Haven, Conn. J. L. Deming.

NATIONAL REGISTRATION OF BIRTHS AND DEATHS.

An article of considerable interest to statisticians appeared in the *Il-nois Law Review* for January, 1915. It is written by Dr. Henry B. Heme-way and bears the title "National Registration of Births and Deaths The author points out the legal difficulties which are often encounter from the fact that our states do not require, in all cases, registration births and deaths. A man residing in one state may wish for certa purposes a proof of his date of birth, and if he was born in a state whi does not require the registration of births, much difficulty may be e perienced. The Constitution requires that persons holding the office representative, senator, vice-president, and president shall have attained certain age. The passage of child labor legislation requires in most case certificate of date of birth. Where a person desiring to obtain work one state was born in a state with no registration of births, it is sometin difficult to establish a date of birth. Dr. Hemenway argues that under su circumstances Congress should have authority to provide for suital registration of births.

The author advises that the Gordian knot be cut by a federal law requ ing every state to register births and deaths. In those states which ha not taken any steps in this matter, the state authority should be igno and a service established by the federal government.

W. B. B

HOW DO THE GERMAN PEOPLE GROW IN ONE HOUR

Translation of an article on the growth of the German people which a peared in the monthly paper of the Victoria in Berlin, No. 8, 1914.

There are, perhaps, few people who know that Germany had in ea hour, according to statistics for 1910, 225 births and 125 deaths, so that t German people have an excess of births over deaths of 100 in each ho How this movement of the population takes place in one hour is visuali by means of a large board which is displayed at the present exhibition physical culture in Stuttgart. In Germany a child is born every 16 secon and a person dies every 28 seconds which events are indicated by red a black flashing lights. When the hour hand marks the hours, th appear 116 male and 109 female births; six times in one hour a stillbi is indicated, and twice in one hour twin births. Considerably slov than life does death work, but still too fast for our state of civilizati Every 1⅔ minutes there dies in Germany an infant (20 boys and 15 gi in one hour). This mechanical device also illustrates certain causes death: Every 4½ minutes there occurs one death from tuberculosis, eve 10 minutes one from malignant disease; three times in one hour a pers dies by an accident and twice suicide is committed. There die in G many more people by accident and suicide than from diphtheria, scar fever, measles, and typhoid taken together. At the end of one hour see the net result: The German nation has increased by 100 lives.

F. L. H.

NEW SERIES, No. 110. (VOL. XIV.) JUNE, 1915.

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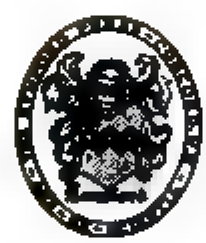


CONTENTS.

AMERICAN
STATISTICAL ASSOCIATION

NEW SERIES, No. 110. JUNE, 1915.

PUBLIC SERVICE STATISTICS IN THE UNITED STATES.*

By Julius H. Parmelee, *Statistician, Bureau of Railway Economics.*

In discussing the development of public service statistics in the United States, I purpose, first, to describe the growth of such statistics in the United States and their status and extent at the present time; second, to discuss the defects that seem to stand out most prominently; finally, to suggest what function, if any, the American Statistical Association and its members may have in the work of remedy and improvement.

Turning first to the definition of *public service*, in its broadest application it comprises all activity that has within it the nature or aspect of a public calling. In this aspect any corporation catering to the public is a public service corporation, as a manufacturing company, or a trading company, or a corporation engaged in commerce or finance. In a narrower application the public service category covers the efforts of all individuals or corporations serving the public in a general capacity, as for example a horse doctor, a smith, an innkeeper, a public entertainer, a theatrical company, or a warehouse corporation. In the generally accepted but limited aspect, however, the term "public service" covers the activities of corporations that furnish the general public with a widely distributed and necessary utility, such as transportation, communication, heat, light, power, and water. Under this heading come steam and electric railway companies; marine navigation and canal companies; express, telegraph, and telephone companies; and so-called public utility companies.

Public service statistics may be defined as the statistical facts concerning (1) corporations engaged in public service

*Paper presented at the annual meeting of the American Statistical Association, Princeton, N. J., December 29, 1914.

and (2) their activities. They relate especially to number c companies, the extent of their operations, and the physica and financial results of operation.

Public service statistics are compiled and published b various agencies in the United States. The federal goveri ment has for years collected and disseminated statistics c many kinds. Recently there has been marked activity by th several states, through public service or utility commission bureaus of statistics, labor bureaus, and various other stat institutions. Statistics are also gathered at the present tim by a number of large cities through various departments.

In addition, many private organizations are engaged in th collection and tabulation of public service statistics. Amor these are associations of corporations engaged in public se vice, such as the American Railway Association and th Bureau of Railway Economics among the steam railways, tl American Electric Railway Association and the Massachuset Street Railway Association among the electric railways, tl National Electric Light Association, the Public Service Ass ciation of Virginia, and so on. Finally we have statisti promulgated by corporations themselves engaged in pub service, in the form of annual reports to regulating bodi periodical reports to stockholders, or communications to t general public.

Steam railway construction in the United States commenc with the Baltimore & Ohio Railroad. The first statistic table relating to railway operation in this country was co tained in the first annual report of the Board of Enginee of that railway, dated September 30, 1828, which present in tabular form an "approximate estimate of expenditur incident to the service" of the Baltimore & Ohio during t year ended August 31, 1829. The Baltimore & Ohio Railro and other roads as they came into being have from the begi ning made annual reports to their stockholders, containi more or less statistical matter.

The first attempt by public authority to gather steam ra way statistics in the United States was in the state of Mas chusetts, which in 1836 required "the directors of every su

(railroad) corporation, from year to year, to make report to the legislature, under oath, of their acts and doings, receipts and expenditures, under the provisions of their charter." A later Massachusetts statute of 1846 specified the items to be covered by the railways in their returns, among which were returns of casualties.

I have examined Massachusetts Senate Document 49 for 1836, containing the annual reports of five railways for 1835. The series is headed by the report of the Andover and Wilmington Railroad Corporation, giving merely the amounts received and expended during the year. The reports of other roads are hardly more detailed.

Massachusetts was closely followed by New York, where a resolution of the Assembly in 1843 directed the several railroad companies of that state to furnish the secretary of state certain statistical information each year. This was tabulated by the secretary of state and submitted annually to the Assembly in pamphlet form. Assembly Document No. 129, for example, dated March 1, 1845, presents statistics for fifteen of the twenty railways of the state, covering the operations of the year 1844, and gives the following statistics: mileage, cost of construction, maintenance expenses, freight and passenger receipts, dividends, horses and equipment, machine shops, freight and passenger train miles, passengers carried, and in most cases statistics of employees.

Other states, especially in New England, also made early provision for the collection of railway statistics, but not until the creation of the first state railway commission was the field of public service statistics really covered. While Rhode Island had a so-called railroad commissioner as early as 1844, the first railroad commission was created in New Hampshire in that year, a body of general railroad commissioners in Connecticut in 1853, boards of railroad commissioners in New York and Vermont in 1855, and a railroad commission in Maine in 1858, followed by Massachusetts in 1869 and Illinois in 1871. In fact, prior to the passage of the federal interstate commerce act of 1887, a majority of the states had established regulative or advisory railway boards or offices. At the present time only three states—Delaware, Utah, and Wyoming—have no rail-

way, public service, or corporation commission with jurisdic-tion in some form over railways.

Statistical work has been carried on by the federal govern-ment from its very establishment, the earliest effort bein centered on decennial censuses. An act of 1820 provided fo the collection of commercial statistics, and also of the amoun or tonnage of *navigation employed in foreign trade*. This wa the first provision for public service statistics in the Unite States.

The Federal Bureau of Statistics came into existence in 184 in the shape of a group of clerks in the Treasury Departme assigned to purely statistical compilation. The entry of th federal government into the field of railway statistics wa however, relatively late. The general appropriation act 1875 created a division of internal commerce in the Bureau Statistics, and provided that this division should, amon other things, compile "statistics and facts relative to . . . the railroad systems of this and other countries, the con-struction and operation of railroads, the actual cost of suc construction and operation of railroads, the actual cost transporting freight and passengers on railroads and on canal rivers, and other navigable waters of the United States, th charge imposed for such transportation of the freight an passengers, and the tonnage transported."

This division of internal commerce of the Bureau of Stati-tics, in its first report, June 30, 1876, described the princip trunk railroads of the country and presented a few transporta-tion statistics. In 1878 there was created the office of audito of railroad accounts in the Interior Department, later calle the commissioner of railroads, whose duties were to prescrib a system of reports from all railways receiving aid from th government. The second report of the auditor, published i 1880, contained a statement of the condition of the Pacifi railroads, statistics of railway accidents, and a comparison certain railways for 1878 and 1879. Later reports containe also statistics of railway construction and development, an of railway indebtedness.

The act to regulate commerce was approved February 4 1887. The important section of the act, so far as the collec

ion of statistics is concerned, authorized the Interstate Com-
merce Commission to require annual reports from common
arriers containing statistics of capital stock, dividends, sur-
lus, stockholders, funded debt and interest, cost and value of
ailway property, franchises and equipment, amounts expended
or improvements and the character of such improvements,
mployees and their salaries, earnings and receipts, operating
nd other expenses, profit and loss, and a complete exhibit of
nancial operations each year, including an annual balance
heet. The act further authorized the Commission within its
iscretion to prescribe a uniform system of railway accounts.

This section, amplified in many details, remains today the
uthorization upon which the Commission bases its system of
niform accounts and detailed statistical reports from the
arriers. Additional legislation has strengthened the hands of
e Commission in enforcing its accounting and statistical
gulations, exacting penalties for non-compliance, and exer-
sing strict supervision by means of a corps of special ex-
miners.

The first statistical report of the Interstate Commerce Com-
ission appeared as a part of its annual report, and covered the
perations of the railways of the United States for the fiscal
ear ended June 30, 1888. Since then the annual statistical re-
rts of the Commission have grown in size and detail, and are
w, in bulky volumes of seven or eight hundred pages, impor-
nt source-books for the student of transportation problems.
he statistical field covered in these reports has been consider-
ly broadened to cover the detailed accounting practices of
e railways, intercorporate relationships, extensions and im-
rovements of property, balance sheet details, traffic, and
any other features.

In addition, the Commission issues monthly statements of
ilway revenues and expenses, quarterly statistics of acci-
nts, annual returns of the express and sleeping car indus-
ies, and periodical statistics as to safety appliances, boiler
efects, hours of service, and the like.

The reports required by state railway commissions from the
ilways operating in their territory are similar to the reports
quired by the Interstate Commerce Commission from the

same roads. In fact, the Interstate Commerce Commission for some time has furnished many of the state commissions blank report forms into which the railways of the several states shall transcribe their returns for such commissions. Three fourths of the state commissions are so supplied at the present time. These report forms correspond to the report form of the Interstate Commerce Commission itself, except that the pages designed for entries regarding mileage, improvement of physical property, revenues and expenses, taxes, and traffic are adapted to show the conditions in each respective state. Certain items not distributable according to states are exactly the same for all forms. From the point of view of the railways concerned, it is highly advantageous that the report forms of the Interstate Commerce Commission and the various state commissions are practically uniform. Imagine such a railway system as the Santa Fe, which operates through twelve different states, being required to maintain its operating statistics according to twelve different accounting systems, in addition to the uniform system imposed by the federal commission. From the point of view of the student of general railway statistics, however, this coöperation between state and federal commissions is of little interest, for the important and significant annual returns of capital, income, balance sheet items and the like, made by a railway to the federal commission, will be found repeated practically without change in the statistical reports of as many states as are entered by the lines of that railway. The result is that the reports of the several state railway commissions, however valuable they may be from the regulative point of view, throw little new light upon the intrastate operations of railway companies. There are, however, exceptions to this rule, such as the reports of the Illinois, New York, Texas, and Wisconsin state commissions.

From the beginning, railway corporations have submitted periodical reports to their stockholders. The earliest was the report of the president of the Baltimore & Ohio Railroad, dated October 1, 1827, which was nothing more than an indefinite four-page prospectus of the plans of the company. Since then the reports of this and other railway companies have

rown continually in scope and detail. With the development ' a uniform accounting system by the Interstate Commerce ommission, the reports of the steam railways to their stock- olders have tended more and more toward uniformity, com- rability with past years, and clarity of statistical presentation. here is no question that this system of uniform account- g has greatly improved the privately compiled statistics steam railways in this country. When it is noted that e railway mileage of the United States is greater than e aggregate railway mileage of the continent of Europe, the gnificance of the last remark will be clear, for to survey the erations of 250,000 miles of railway with anything like clear sion requires uniformity of statistics throughout.

In addition, the larger railways often prepare and issue neral statements for public consumption, many of which are atistical in nature. These statements, like the annual re- rts of the companies, are prepared for the most part in well- uipped statistical offices, which are maintained by many of e principal railways. These offices are of great service also the officials of their respective railways, preparing statistical emoranda that shall enable them to keep in touch with the tails of current operation.

Furthermore, the American Railway Association and other öperative associations do considerable statistical work, while is becoming increasingly the custom for the railways to öperate on a large scale in the preparation of statistical hibits for presentation in wage arbitrations, rate cases, and like. Recent examples of this coöperation have recently curred in the Five Per Cent. case of the Eastern railways, d in the wage arbitration of the Western railways and eir enginemen and firemen.

The first commercial electric railway in the United States s opened for operation in 1881. From no mileage in 1881 nearly 50,000 miles in 1915 is a quicker growth than was own by the first third of a century of steam railway construc- n. Because the new electric mileage of these thirty years been burdened with denser traffic than the steam railways m 1830 to 1860, and because electric railways have doubled

their mileage in the past ten years, it is not strange th electric railway statistics have developed with relative slow ness. Not until 1906, indeed, was the Interstate Commerc Commission given authority to collect statistics of electri railway operation. The Commission first requested report from the electric railways for the fiscal year ending June 3 1908, but no compilation of returns has yet been made. Eve if it had been, such a report would not cover one third of th perhaps 1,600 electric railway companies operating toda and probably not half of the aggregate mileage; for the Con mission has jurisdiction only over lines participating in son form of interstate traffic, and many municipal systems do n come under this head. In fact, in a recent case before t Interstate Commerce Commission, an electric railway compan disclaimed the obligation to report accidents occurring in th course of intrastate operation, although willing to repo accidents in interstate operation. If the steam railways we to make the same disclaimer, and refuse to report any b interstate accidents, it is clear that accident statistics wou be much impaired.

Since electric railway statistics are not compiled by t Interstate Commerce Commission, it is well that the Cens Bureau has since 1890 published reports on street and electr railway transportation. The latest such report covered t calendar year 1912.

More than half the state public service commissions ha unqualified authority over electric railways within the state boundaries. Six or eight other state commissions ha qualified regulative power, applicable only to interurb roads or roads lying outside the principal cities. The annu reports secured by state commissions from electric railway as in the case of steam railways, are based largely upon t report form of the Interstate Commerce Commission. H the states utilize this report form with the necessary modific tions, and the tendency toward uniformity in electric as steam railway statistics is growing.

The Eleventh Census, 1890, presented the first report up the express business of the United States. Like the electr railways, express companies were placed by the Hepburn A

f 1906 under the complete jurisdiction of the Interstate ommerce Commission. These companies make periodical ports to the Commission, which has compiled and published atistics of the twelve principal companies annually for sev-al years.

In addition, the principal companies have been investigated y the Commission; these investigations have gone to the eart of the express business, have ascertained the value of xpress property, have unearthed the relations between ex-ress companies and railways, and have led to drastic changes express rates and regulations.

These changes, together with the growth of the parcel post stem and other business changes, have already led one com-any to withdraw from business, and have affected the prof-able operation of the others. Clearly, statistics of the ex-ress business under these conditions, while interesting, are ot of paramount social significance. Yet about three fifths the state commissions require reports from the express mpanies operating within their boundaries, and are using e report form of the Interstate Commerce Commission, odified to suit their respective needs. A considerable num-r of these states publish annual statistics of express com-anies.

Marine transportation in the United States is so largely an terstate matter that the collection of marine statistics has en left in large measure to federal authority.

We have already seen that in 1820 an act of Congress pro-ded for the compilation of statistics of navigation in foreign mmerce. The census reports of 1850 to 1890 covered canals d improved waterways, and a special census of 1906 dealt ith vessels engaged in water transportation, tonnage, income, eight and passengers, and employees and wages. More re-ently, the Bureau of Corporations has been issuing a series reports dealing with water routes, volume of traffic, termi-als, and form of control. The Board of United States Engi-eers publishes annual statistics of freight tonnage on the nproved rivers and canals, but these are not summarized.

In addition, a few states compile statistics of steamboat

and canal traffic, such as the Erie Canal traffic in New Y-
but students of waterborne traffic will agree with the st
ment that these statistics are far from satisfactory or compl

In fact, there has been nothing in the field of marine sta
tics to compare with the uniform and detailed railway sta
tics filed annually with the Interstate Commerce Commis
and with the several state commissions. Beginning with
calendar year 1914, however, the Commission has orde
carriers by water with annual revenues above $500,000 to
detailed annual reports.

The telegraph is an older institution than the electric r
way, but has not been regarded to the same extent as a pu
service, and only recently has the telegraph field been ente
for regulative purposes by the federal and the state gove
ments. The amendments of 1910 to the interstate comm
act, commonly known as the Mann-Elkins law, gave the
terstate Commerce Commission jurisdiction over telegr
and telephone, wireless and cable companies. Under this
the Commission may require reports from the telegraph c
panies, of which there are two large and a dozen small one
the present time. No such reports have as yet been mad
the Commission. Similarly, no reports are now filed by c
or wireless companies.

It is estimated that 11,000 telephone companies ope
in the United States, exclusive of farmers' lines. These c
panies own approximately 10,000,000 residence and busi
telephones, or one for every two families throughout the co
try. Statistics of telephone operations would not only
extensive, therefore, but should be significant and interest
The Interstate Commerce Commission was granted juris
tion over telephone companies in 1910, and has recently iss
orders to large companies, with annual revenues above $2
000, to file reports beginning with the calendar year 1
Not more than three fourths of the 11,000 companies h
interstate connections, and a very small proportion of th
do sufficient business to come under the requirement of
Commission.

The Census Bureau has published special reports on t

ones and telegraphs covering three years—1902, 1907, and 12. These statistics the Bureau placed in comparison with tistics collected in the census of 1880. The latest bulletin the subject covers practically all the telegraph and teleone companies of the United States.

The field of telegraph and telephone statistics has also been ered by several states, about twenty of which publish perical statistics thereof, and by the private organizations of companies themselves.

Since 1910 the Interstate Commerce Commission has reed annual reports from the Pullman Company. With the eption of pipe lines and sleeping car companies, whose rations are almost exclusively interstate, other forms of lic service are mainly local, such as the operations of gas l electric light plants, power plants, heating systems, water npanies, and the like. These industries are in part covered the Census Bureau in its reports of manufactures and the trical industries, and in its statistics of cities; in part by reports of about twenty state public service or utility comsions; and in part by municipal reports.

t were idle to attempt detailed appraisal of public service istics within the limits of this brief paper. I will merely gest a few general criticisms of federal, state, and private istics. Before entering on this, however, it may be well point out that public service statistics, like all other statis-, should be judged on the basis of serviceability. If statis- do not assist in solving the many problems of today, if y befuddle the brain instead of stating simple truths, they e better not compiled.

The earliest and most consistent complaints of federal istics were directed primarily against their inaccuracy. example, the results of the First Census of 1790 were reded by many with skepticism, and complaints of error e leveled at all the censuses to 1850. Similarly, the earlier k of the Bureau of Statistics, which in the field of railway istics was the predecessor of the Interstate Commerce nmission, was subjected to much criticism on the ground

of error. A commission of investigation reporting on that Bureau in 1877 called its work "so grossly and grotesquely inaccurate as to make the bureau an object of ridicule."

The progress of statistics has been so marked in the past forty years that the same criticism would not apply today to public service statistics as a whole. Yet into the statistical reports of federal and state commissions there creep, even in these latter years of grace, errors of omission and commission. It would be odious to give concrete examples without covering the field in detail, but it is not unfair to remark that the reports of the Interstate Commerce Commission are relatively free from error, when compared with the reports of the average state commission.* An extensive survey of the official railway statistics of foreign countries leads to the further remark that American reports average as high in this regard as most foreign reports. Whatever the results here or abroad, the underlying cause of the errors is carelessness at some point. And as the ultimate goal of statistical work is to present facts, public service statistics cannot be regarded with complacence till inaccuracy shall have been reduced to a minimum.

Another oft-repeated complaint against government statistics protests the delays attendant upon their preparation and publication. The commission of 1877 on the Bureau of Statistics, for example, strongly recommended increasing the timeliness of the reports of that Bureau. That same recommendation could be repeated with emphasis regarding the

*It is not unfair to cite the following from the Annual Report of the Public Utilities Commission of Rhode Island for 1913, pp. 92–93, as a gross form of error.

PASSENGER TRAFFIC.

	Average distance carried.	Average receipts per passenger per mile.
Road A	18.50	$.01737
Road B	5.53	.04033
Road C	2.00	.01841
Total	26.03	$.07611

FREIGHT TRAFFIC.

	Average distance of haul of one ton in miles.	Average receipts per ton per mile.
Road A	96.43	$.01345
Road B	4.94	.12812
Road C	2.00	.01445
Total	103.37	$.15602

Truly, the *addition* of these averages to reach a general average should make the shades of the early New England statisticians start up with a groan!

statistical reports of practically all public service bodies of today. The compilation of statistics gathered from many sources is a slow and tedious process; yet this need not deter complaint when reports are unduly delayed in appearance. When a report on steam railway operations is issued annually, it does not seem unreasonable to expect the issue for a given year to appear before the close of the next succeeding year. Yet such reports have in recent years been delayed eighteen, twenty, and even twenty-five months after the close of the fiscal year to which they applied. So far as the Interstate Commerce Commission is concerned, the improvement in this regard has been notable, and especially in the matter of monthly statements of revenues and expenses, which have continually tended toward currency. Privately compiled statistics of public service also approximate a fair degree of timeliness, but the statistical reports of state commissions are sometimes much delayed. The vital connection between promptness and serviceability in the field of public service statistics hardly needs emphasis, and one has only to consider the close relation between the transportation industry and business in general to realize how important is the current statistical record of that transcendent industry. In this matter of timeliness, we may take Pharisaic satisfaction in that we are no more dilatory than many foreign statistical offices, but when we consider how delayed their reports occasionally are, our satisfaction cannot be great. The official statistics of French railways for the year ended December 31, 1911, for example, were not released till the end of 1913, or two years late; while other countries are at times even more behindhand.

Still another general criticism, closely related to that of inaccuracy, relates to insufficient clearness. Reports lose greatly in effectiveness when their tables are poorly constructed, insufficiently introduced and explained, or carelessly entitled. An ambiguous title over a table is hardly better than no title at all; a table thrown into a report with little or no explanation of its source, its underlying bases, its scope, or its qualifications, is of distinctly less utility than no table at all. Discrepancies among tables should be invariably explained. Furthermore,

a table whose steps are hard to follow, or the significance of whose contents you must stand on your head to appreciate, may be better than nothing, but this the exasperated student is sometimes tempted to deny. To clarify is to simplify, nine times in ten; and there is no more cheerful handmaiden to serviceability than simplicity.

There is room for difference of opinion as to whether interpretative text should accompany statistical tables or not, but if included at all the text should be clear, unambiguous, and sufficient. The parrot-like textual comment that stalks so often through the pages of our public service reports, being repeated page after page in the same report, or year after year in the same series of reports, should be eliminated. It adds nothing to the utility of tabular matter, but tends rather to conceal the salient features of the different tables. The suspicion steals across the brain that this kind of text is prepared either by a statistician who has much to learn, or else is entrusted to junior clerks to be ground out at the rate of so many paragraphs per hour. Few of the reports of our public service commissions are wholly free from this worse than useless custom.

The problem of coördinating the statistical reports of the various branches of the federal government happily does not exist, so far as public service statistics are concerned; for these statistics are entrusted largely to one federal body, the Interstate Commerce Commission, and even where this is not the case, the spirit of coördination and coöperation has been marked. Recent examples are the coöperative efforts of the Commission and the Census Bureau in ascertaining the physical value of railway operating property and in compiling statistics of express companies.

Finally, this comment upon the weaknesses of public service statistics in the United States would be imcomplete unless it registered a vigorous protest against the custom, so prevalent in many reports, of presenting countless pages of detailed tabular matter without adequate summaries or logical arrangement. In some cases, even, no attempt is made at tabular presentation. Nine tenths of the expenditure underlying statistical work that sees the light in such form has been

wasted, yet some state commissions publish reams of statistics of this nature every year.* These same commissions usually add to their other statistical vices that of trying to give too much information, with the result that their reports are not only badly arranged, but contain much data of little value. This is a waste of time and money, and greatly contributes to unintelligibility.

We have seen how the development of public service statistics of all kinds has proceeded during the past few decades, and have briefly reviewed the present situation. Is the statistical work now under way worth the energy and the millions of expenditure it involves, should it be added to and increased, or is it rather the wise thing to curtail it?

In this connection, I wonder if students of modern social problems do not sometimes feel themselves in the position of the boy in the legend who took on board ship a mill which upon the repetition of certain magic words would commence grinding salt. The boy uttered the words and the mill started grinding, but when he desired to stop the mill, he found he lacked the necessary formula. In spite of efforts, the mill continued to grind salt until it sank the ship to the bottom of the sea. Legislatures and statisticians have in the past been winding up the mills that grind out year after year countless statistics of the public service. Are we not inclined at times to feel that we have lost the formula for stopping the mills?

However this may be, I think few students believe, and possibly still fewer hope, that public service statistics should be collected and compiled in any less detail than at the present time. Indeed, the majority would doubtless assert that the commanding need is for greater detail, especially in the way of uniform accounting methods, cost accounting systems, statistics of corporate relationship, and the physical statistics of operation. Into this discussion of the lines along which statistics of public service should or will develop, it is not the function of this paper to enter.

* Thus the seventh annual report of the Railroad Commission of Oregon, December 15, 1913, contains over eighty pages (pp. 155-237) of closely printed statistical matter presented almost wholly in running text, without tabular arrangement.

Indicating in this general way that public service statistics are likely to increase in detail and in complexity, the next question relates to the functions of this Association with regard to such growth. Should we as a body take formal steps to influence the development of public service statistics along any lines? The American Statistical Association has in the past taken such action. For example, in 1843 this Association, then four years old, submitted a memorial to Congress severely criticising the census statistics of 1840. Is it the function of this Association to revive or continue what may be termed high-grade lobbying practices with regard to the development of public service statistics in the future?

It seems to me that the answer to this question should be a negative, at least until our membership feel more strongly that the Association should enter polemic fields to influence the progress of statistical work in lines of public service activity. This need not prevent the Association, however, from entering dignified protest, through the regular officials or through standing or special committees, whenever it is deemed essential. For example, if a public service commission should be issuing grossly inaccurate or distinctly unfair statistics, it appeals to me the machinery of this Association could not be better employed than in creating a sentiment of disapproval among statisticians and in preparing formal protest to be lodged with the proper authorities.

The functions of the individual members of the Association, moreover, should be exercised in the way of assisting the progress of statistical work wherever they come into contact with it. If they see opportunity for suggestion or kindly criticism at any point, it is their duty to seize the opportunity. If they have views as to the proper lines along which public service statistics should be developed, they may well devote their energies to that development. If their sentiment leans toward curtailment, that certainly is their field of effort. In any case, they can and should devote their heartiest efforts toward improving public service statistics of all kinds, making them more accurate, more nearly complete, more illuminating, and in every way more serviceable.

INFANT MORTALITY IN FALL RIVER, MASSACHUSETTS—A SURVEY OF THE MORTALITY AMONG 833 INFANTS BORN IN JUNE, JULY, AND AUGUST, 1913.

By Louis I. Dublin, Ph.D., *Statistician, Metropolitan Life Insurance Company.*

The present study of infant mortality in Fall River originated with the Civic Department of the Woman's Club of that city, which was interested in practical measures for reducing the high infant death rate known to exist there. The data for the investigation were collected by the members of the District Nursing Association of Fall River; the information was later transcribed upon the infant mortality blank prepared by the Russell Sage Foundation. The author of this paper holds himself responsible neither for the blank used in the compilation nor for the completeness of the record of the various items tabulated. He has reason to believe, however, that the records which have come under his sight for study have been prepared with care, and that they are in all probability accurate statements of the conditions found by the members of the Nursing Association at the time of their visits.

This investigation covers the history of 833 infants born in Fall River during a period of 3 months—June, July, and August, 1913. These cases were not all registered at the time of birth. A thorough method of canvassing was employed by the nurses to locate babies born during these three months; some were not discovered until their death certificates were examined. Babies were visited from time to time, and a record was made of the findings at each visit. This record covered the condition of the baby, that of the mother, the mode of feeding, housing conditions, and other items of interest. A final visit was made on the anniversary of birth, at which time a fairly complete record was made.

Of the 833 births, 30 were recorded as stillbirths. One hundred and fifty-two additional deaths are known to have

occurred in the course of the year. No data are available for one of these deceased infants; it has seemed wiser, therefore, to eliminate it both from the records of births and from those of deaths. This study will be concerned, then, with 30 still-births, 802 live births, and 151 deaths.

Death Rate. If the 802 infants born alive had been kept under observation throughout the entire year, or until earlier death, the death rate in Fall River would have been 187 per 1,000 live births. As a matter of fact, 116 infants were lost from observation during the year. Of this number, 22 were under observation less than 1 week, 28 less than 1 month, and 106 less than 4 months. None of the 116 was under observation more than 6 months. The death rate of 187 per 1,000 is therefore an underestimate, since some of these 116 children, in all probability, died outside of the confines of Fall River and were not recorded as deceased. We have, therefore, constructed the annual death rate by summing up the 4 quarterly death rates, correcting the denominator at each period for departures of infants from observation. These 4 quarterly rates are 131.8, 15.1, 36.4, and 19.0, respectively. The annual death rate is therefore 202.3.

It should be remembered that this rate of 202.3 per 1,000 live born is for a limited number of infants born during the three summer months of June, July, and August. As will be shown later, there was a high mortality during the first few weeks of life, which was doubtless due, in part, to the effects of the season. This death rate must not, therefore, be considered as identical with the annual death rate, which is probably somewhat lower than this figure. According to Verrill,* the infant mortality rate in Fall River was 177.6 per 1,000 births in 1908; the Children's Bureau gives it as 186 per 1,000 in 1910. In any case, the rate in Fall River is almost twice as high as that now recorded for a number of large cities where efforts have been made to conserve infant life.†

* Infant Mortality and Its Relation to the Employment of Mothers in Fall River, Mass. Charles H. Verrill, U. S. Bureau of Labor. Transactions of the Fifteenth International Congress on Hygiene and Demography, Washington, 1913, pp. 318–337.

† In this discussion we have assumed the identity of the death rate and the infant mortality rate. This involves a slight error, which is not, however, sufficiently significant to justify an attempt at correction.

Stillbirths. There were 30 stillbirths in the series of 832 births—a rate of 36.0 per 1,000 births. This rate compares favorably with that of other cities. The number of stillbirths per 1,000 born as recorded for Johnstown, Pennsylvania, in the recent study by Emma Duke for the Children's Bureau,* was 56.7 for the year 1911; that for the city of New York for the year 1912 was 46.5; and that in the series of 10,000 cases born at Sloane Hospital † and studied by Holt and Babbitt was 44 per 1,000. The last figure excludes abortions.

The mothers of 8 of these 30 stillborn children were occupied in the mills during pregnancy; 19 mothers were engaged in housework only. The stillbirth rate was higher among the workers than among the housekeepers, the rates being 44 and 31 per 1,000, respectively. It should also be noted that 21 of these stillborn children were delivered by physicians and 6 by midwives; the stillbirth rate was then 40 per 1,000 for the former group and only 23 per 1,000 for the latter. The much higher rate for those delivered by physicians is doubtless influenced by the fact that physicians are likely to be called in cases which present difficulties too great for the midwives to handle.

Sixteen of the stillborn were males and 8 were females; the sex of the remaining 6 was not stated. Six, or 20 per cent., of the stillborn were premature.

Age at Death. The following table gives the number and percentage of deaths, and the rate per 1,000 live births, for each period of life:

* Infant Mortality: Results of a Field Study in Johnstown, Pennsylvania, Based on Births in One Calendar Year, by Emma Duke. Children's Bureau, U. S. Department of Labor, Washington, 1915.

† Institutional Mortality of the New-born. Holt and Babbitt. Journal of the American Medical Association, January 23, 1915, pp. 287-290.

TABLE I.

INFANT DEATHS, PERCENTAGE OF TOTAL, AND DEATH RATE, BY PERIOD OF LIFE.

Period of Life.	Deaths.		
	Number.	Per Cent. of Total.	Rate per 1,000 Births. (a)
1st Year	151	100.0	202.3
1st day	25	16.6	31.2
1st week	37	24.5	47.4
1st month	62	41.1	79.7
1st quarter	102	67.5	131.8
2d quarter	11	7.3	15.1
3d quarter	25	16.6	36.4
4th quarter	13	8.6	19.0

(a) This column is corrected for the 116 infants who were lost from observation during the year.

The greater part of the mortality occurred during the first few weeks of life. The figures are in general similar to those presented for Johnstown by Miss Duke, and confirm the findings of Holt and Babbitt for the births studied at Sloane Hospital. The percentage of all deaths occurring during the first quarter year, 67.5, is higher than that found by Miss Duke for Johnstown, where the figure was 55.1. The corrected death rate for the first quarter, 131.8, is also much higher than that recorded by Verrill for Fall River for 1908; namely, 72.3. Our series, then, does not justify the comment of Verrill that the excessive infant mortality of Fall River is to be found, not in the earliest period of life, but at the ages over three months. Our conclusion must be that the excess of infant mortality is pronounced all along the line, being especially marked during the first month and, indeed, the entire first quarter year of life. It is also possible, of course, that the difference between the results of the two Fall River studies can be accounted for by the fact that our series is one of summer-born children, whereas that of Verrill covered the entire year.

A considerable number of the infants under observation were evidently born with serious physical defects, which resulted in death during the period soon after birth. A number of factors involved in this phenomenon present themselves for

consideration. We shall first attempt to get additional light on the subject from an examination of the causes of death.

Causes of Death. There were available for this analysis of cause of death not only the statement registered on the death certificate by the physician, but, in many cases, the statement of the visiting nurse as well. This additional information was often of value in the assignment of the case to the true cause. Thus the physician's statement of "Pneumonia" was in some instances supplemented by the nurse with the additional information of the existence of an acute infection such as whooping cough. The latter condition was given preference in our assignment. But where there was an actual conflict of causes in the two statements, preference was invariably given to that registered by the physician. Table II presents the number and per cent. of deaths by cause and by age at death.

TABLE II.

NUMBER AND PER CENT. OF DEATHS BY CAUSE AND BY AGE AT DEATH.

International List Number.	Cause of Death.	Deaths by Period of Life.								
		1st Year.		1st Day.	1st Week.	1st Month.	1st Quarter.	2d Quarter.	3d Quarter.	4th Quarter.
		Number.	Per Cent. of Total.							
	All Causes	151	100.0	25	37	63	102	11	25	13
104	Diarrhea and enteritis	50	33.1	—	1	13	42	2	2	4
151	Congenital debility, icterus, and sclerema	*31*	*20.5*	*13*	*17*	*24*	*28*	*2*	*1*	—
	(1) Premature births	17(a)	11.3	12	16	17	17	—	—	—
91	(2) Congenital debility	14	9.3	1	1	7	11	2	1	—
152	Bronchopneumonia	16	10.6	—	—	—	—	4	6	6
	Other causes peculiar to early infancy	*15*	*9.9*	*8*	*15*	*15*	*15*	—	—	—
	(1) Accidents of labor	8	5.3	3	8	8	8	—	—	—
92	(2) Other causes peculiar to early infancy	7	4.6	5	7	7	7	—	—	—
150	Pneumonia (including lobar)	8	5.3	—	—	—	2	—	6	—
	Congenital malformations	*8*	*5.3*	*4*	*4*	*7*	*7*	*1*	—	—
	(2) Congenital malformations of the heart	6	4.0	3	3	5	6	1	—	—
9	(3) Other congenital malformations	2	1.3	1	1	2	2	—	—	—
89	Whooping cough	7	4.6	—	—	—	3	—	4	—
28	Acute bronchitis	6	4.0	—	—	1	2	1	2	1
	Tuberculosis of the lungs	2	1.3	—	—	—	—	—	1	1
	All other causes	8	5.3	—	—	2	3	1	3	1

(a) Eight additional premature births were reported in conjunction with other causes.

The largest number of deaths was due to the group of causes embraced by the designation "Diarrhea and Enteritis" (title 104 of the International List); 50 deaths are so recorded, or about one third of the total. Of these, 13 occurred during the first month of life and 29 during the second and third months. It would appear that the latter months constitute a particularly dangerous period for the infants, since it is then that the change from breast feeding to other methods commonly occurs.

Other observers have similarly found that babies born during the summer show a high mortality from intestinal disturbances during the early months of life. Doubtless the danger is aggravated by exposure to the summer heat. The mortality from this group of causes during the second, third, and fourth quarters of the first year was very much reduced, although by no means negligible.

The proportion of "Diarrhea and Enteritis" to "All Causes," 33.1 per cent., is considerably higher than that usually found in other localities. The figure may be compared with the following percentages for 1913 for the Registration Area and a number of large cities.

PERCENTAGE DEATHS FROM DIARRHEA AND ENTERITIS OF DEATHS FROM ALL CAUSES UNDER ONE YEAR OF AGE, 1913.

Registration Area, United States	24.1
New York City	23.4
Boston	22.3
Detroit	19.4

Verrill, in his report on Fall River conditions in 1908, found an even higher proportion than ours; namely, 38.3 per cent. of the total. The ratio of diarrhea and enteritis deaths to deaths from all causes under one year of age, as reported for Fall River by the Bureau of the Census for the entire year 1913, was 34.9. Verrill ascribed the excessive mortality from these causes to the ignorance of mothers in feeding their infants. All other causes, according to him, take a secondary place. We shall later on consider this question in order to determine from our data what effects have been exerted on the mortality by the various methods of feeding employed by mothers. We

are warranted at this time, however, in concluding that the proportion from diarrhea and enteritis is too high, and that it is capable of very marked reduction if attacked along lines similar to those now well established in New York City, Boston, and Detroit.

As might be expected from the large proportion of early deaths, the causes included under the designation "Congenital Debility, Icterus, and Sclerema" form a very important group. Together they embrace 20.5 per cent. of the deaths. Of the 31 deaths under this title, 17 were stated as "Premature Births" with no further qualification. Eight additional premature births were reported in conjunction with other causes, and preference was given to the more definite statement. Thus 3 additional deaths were due to "Atelectasis" and 2 more were ascribed to "Accidents of Labor." These 5 cases appear in our table under title 152 of the International List, "Other Causes Peculiar to Early Infancy." Of the 3 remaining premature births, 2 cases are assigned to "Congenital Debility" (title 151), and 1 case to "Diarrhea and Enteritis" (title 104). There were, therefore, 25 deaths of prematurely born children in the total of 151 deaths, or 16.6 per cent.; this is an extraordinarily high proportion. Of these 25 children, 22 died during the first week of life. It is interesting to note also that 46 deaths of the 62 which occurred in the first month are traceable either to "Premature Birth," "Congenital Debility," "Accidents of Labor," or congenital malformations of one kind or another. All these causes point with especial emphasis to prenatal conditions and to the character of the obstetrical treatment which mothers in Fall River receive.

The respiratory diseases comprise 16 cases of bronchopneumonia, 8 cases of unqualified or lobar pneumonia, and 6 cases of acute bronchitis, a total of 30 cases. Of this number only 9 occurred in the first half year of life and 21 in the second half year. It is quite possible that these cases have been increased in number at the expense of the acute infections of which they may have been terminal conditions, although every effort has been made to assign to the infections (such as whooping cough, diphtheria, etc.) those cases in which there was sufficient evidence to warrant such action.

The acute infections are represented by whooping cough to the number of 7 cases and by diphtheria in 1 case. There were 2 cases of pulmonary tuberculosis and 7 other cases due to as many different causes.

Contributory Factors in Mortality. Infant mortality is the resultant of a considerable number of contributory factors. Some of these are primarily biological in character; others are principally economic and social. In the very nature of the case it will be impossible to measure with any degree of accuracy the effect of each on the mortality, yet together they determine whether the infant death rate of a community shall be high or low. In our discussion we shall take up in sequence the following factors, and shall point out how they bear on the conditions which we have found to exist:

(a) Attendance at delivery.
(b) Infant feeding.
(c) Age of mother.
(d) Nativity of mother.
(e) Occupation of mother.
(f) Occupation and wages of father.

(a) The following table shows the facts of infant mortality according to whether physicians or midwives assisted at delivery:

TABLE III.

NUMBER OF BIRTHS, CORRECTED NUMBER OF BIRTHS, NUMBER OF DEATHS, AND DEATH RATE, BY ATTENDANT AT BIRTH.

Attendant at Birth.	Number of Births.	Corrected Number of Births.(a)	Number of Deaths.	Rate per 1,000 Births.(a)
All Forms of Attendance....	802	746	151	202.4
Physician................	507	483	96	198.8
Midwife..................	254	239	45	188.3
Other and unknown.......	41	24	10	—

(a) Correction has been made in this and in subsequent tables (except in Table IV) for the 116 cases lost from observation. The death rate for the entire group, 202.4, is slightly different from that given in Table I, because of the use of 746 instead of 746.4 as the denominator.

It would appear that the children born with physicians in tendance exhibited a much higher mortality rate than those rn under the care of midwives. The numbers coming under e other heads are not sufficiently large to warrant their clusion in the table. A considerable proportion, 49 per nt., of the deaths among the children born under the care physicians occurred during the first month of life; the rresponding figure for those born with midwives in attendce was only 27 per cent. It is to be assumed that these ferences are primarily the result of a process of selection, ysicians having been called in those cases which presented ecial difficulties for either mother or child. Such cases uld naturally show a higher death rate during the first year life.

(b) So much importance has been ascribed to feeding that st investigations of infant mortality have resolved themves into studies of the mode of feeding. Whether the child breast fed or artificially fed, and how long breast feeding is rried on, are the best indices of the infant death rate to be pected. Such, in particular, were the findings of Verrill in painstaking analysis of the situation in Fall River for the ar 1908. He attributes the excessive mortality among the ldren of mothers at home to the absence of nursing and to proper feeding and improper care. "The much higher rtality among children of the mothers who went to work er childbirth," he says, "is plainly due chiefly to the greater ent of the absence of breast feeding and of the improper ding and the additional evil influence of the withdrawal of mother's care."

Our own analysis leads to an identical conclusion. Beging with the second week of life, infant feeding is clearly the ef factor in the mortality. From this period onward, all er considerations take a secondary place. In the following le we have analyzed the mortality of the children as to ether they were breast fed or artificially fed, in whole or in rt, at successive periods. We have for obvious reasons minated from this analysis the 116 infants who were lost ht of during the year. Nor have we considered the 37 ants that died during the first week, since they would hardly

reflect the influence of feeding. At the initial period, namely, the beginning of the second week, there remained for consideration 649 infants. These are traced to the conclusion of the first year or to earlier death. The death rates at each period show how markedly the mode of feeding affects the chances of survival.

TABLE IV.

NUMBER ALIVE AT TIME STATED, NUMBER OF DEATHS DURING REMAINDER OF YEAR, AND DEATH RATE, BY MODE OF FEEDING.

Mode of Feeding at Time Stated.	Number Alive at Time Stated.	Number of Deaths During Remainder of Year.	Rate per 1,000 Alive at Time Stated.
Beginning of 2d week: Total	649	114	175.7
(a) Breast feeding	565	74	131.0
(b) Artificial and mixed feeding	76	32	421.1
(c) Unknown	8	8	—
Beginning of 2d month: Total	624	89	142.6
(a) Breast feeding	514	52	101.2
(b) Artificial and mixed feeding	105	32	304.8
(c) Unknown	5	5	—
Beginning of 4th month: Total	584	49	83.9
(a) Breast feeding	405	26	64.2
(b) Artificial and mixed feeding	178	22	123.6
(c) Unknown	1	1	—
Beginning of 7th month: Total	573	38	66.3
(a) Breast feeding	368	18	48.9
(b) Artificial and mixed feeding	205	20	97.6
Beginning of 10th month: Total	548	13	23.7
(a) Breast feeding	335	7	20.9
(b) Artificial and mixed feeding	213	6	28.2

It is obvious, from the above table, that the breast fed infants are at every period better endowed for living than are the artificially fed. Furthermore, the seriousness of the handicap of the latter depends upon the shortness of the duration of breast feeding. Infants that were already artificially fed at the beginning of the second week showed the highest mortality, namely, 421.1 per 1,000. The corresponding rate of the breast fed was 131.0—less than one third as high.

At the beginning of the second month, the rates for the breast fed and the artificially fed infants were reduced to 101.2 and 304.8 respectively. The rate for the artificially fed was still three times as great as that for the other infants. At the beginning of the fourth month, the artificially fed children suffered from a mortality almost twice that of the

breast fed. This condition continued until the beginning of the seventh month. At the beginning of the tenth month, the difference in the death rates was comparatively slight for the two modes of feeding.

It is noteworthy that, of the 535 children that survived the year, 350, or 65.4 per cent., were breast fed for at least 6 months. Of this number, 328 were breast fed for at least 9 months. Breast feeding not only determines the chances of survival during the first year, but also affects the condition of the survivors at the end of the year. Of the 535 infants, 489 were in good condition at the beginning of the second year, 19 were said to be in fair condition, and 27 were poor. Of these 27, 17 were breast fed less than 6 months and 13 less than 3 months. It is in this way, perhaps, that the mode of feeding, in the first year, makes its influence felt on the mortality of the second and subsequent years.

(c) The age of the mother also influences the mortality of infants during the first year of life, as is shown in the following table:

TABLE V.

NUMBER OF BIRTHS, CORRECTED NUMBER OF BIRTHS, NUMBER OF DEATHS, AND DEATH RATE, BY AGE OF MOTHER.

Age of Mother.	Number of Births.	Corrected Number of Births.	Number of Deaths.	Rate per 1,000 Births.
All Ages.........	802	746	151	202.4
Under 20.................	33	29	3	103.4
20-29....................	408	386	73	189.1
30-39....................	267	257	53	206.2
40 and over..............	37	36	8	222.2
Unknown..................	57	38	14	—

The lowest death rate occurred among infants of mothers whose age was 20 and under; but this figure is hardly trustworthy in view of the small number of cases under observation. From age 20 onward, the mortality increased regularly with the age of the mother, the highest rate being among infants of mothers at ages 40 and over.

It is difficult to interpret the above rates in view of the many conflicting factors that enter into the discussion. In the first

place, it is proper to assume that the knowledge and skill of mothers in infant rearing increases with age. Other conditions, however, are apparently of sufficient force to more than negative the favorable effect of the increased experience of the mother. It is possible that with successive pregnancies the inherent weaknesses transmitted by mothers to their offspring become more pronounced. In addition, economic and social conditions, certainly among industrial workers, become more acute as the family increases in number, so that the vitality of the infant is impaired, not only through its prenatal but also through its postnatal environment. In any case, it is interesting to observe that a higher infant death rate has been noted by many authors to be correlated with the advancing age of mothers.

(d) The mortality of infants of foreign born mothers has been shown to be considerably higher than that of infants of native mothers in a number of American communities, including New York City, Boston, and Johnstown. The following table for Fall River confirms these findings:

TABLE VI.

NUMBER OF BIRTHS, CORRECTED NUMBER OF BIRTHS, NUMBER OF DEATHS, AND DEATH RATE, BY NATIVITY OF MOTHER.

Nativity of Mother.	Number of Births.	Corrected Number of Births.	Number of Deaths.	Rate per 1,000 Births.
All Countries........	802	746	151	202.4
United States.............	253	242	37	152.9
Portugal and Azores.......	182	174	52	298.9
Canada..................	151	145	25	172.4
All other countries.........	216	185	37	200.0

The lowest mortality rate is found among infants of native mothers; the highest rate is among infants whose mothers came from Portugal and the Azores, reaching the unprecedented figure of 299 per 1,000. The inclusion "All Others," for which the rate is 200 per 1,000, embraces a considerable number of nationalities. Thirteen countries in all are represented, but the numbers for the individual countries under this heading are too small to warrant special treatment.

It is not our view that the fact of nationality is itself sufficient to determine the above differences. Foreign born mothers are probably as well equipped physically to bear healthy offspring as are native mothers. It is rather to be inferred that the mother's nativity is correlated with other conditions which play a very decisive part in determining the infant death rate. The foreign born mother in Fall River, for example, is more likely to work in the mills during pregnancy, to have many children, and to live in crowded and unhygienic quarters. She, more than the native mother, reflects the injurious influences of an unfavorable industrial and economic environment. We find, accordingly, that the excessive deaths of the infants of foreign born mothers are due especially to pneumonia, to diarrhea and enteritis, and to premature birth and congenital debility.

We may illustrate the above with reference to the infants of Portuguese mothers, who showed the highest death rate. Of the 182 mothers, 72, or 39 per cent., were engaged in work outside of the household during pregnancy, while only 17 per cent. of the mothers of other nationalities were so engaged. Of the 52 deaths of Portuguese children, 20 were due to diarrhea and enteritis, 17 to pneumonia and bronchitis, and 13 to prematurity, congenital debility, and other causes peculiar to early infancy.

(e) The participation of the mother in gainful work during pregnancy has been the subject of numerous investigations, from which the conclusion has usually been drawn that such work involves a high infant death rate as a consequence. We have, therefore, examined with special interest the data at our disposal, in order to determine, if possible, the relation existing between occupation of mother and infant mortality. The following table presents our results:

TABLE VII.

NUMBER OF BIRTHS, CORRECTED NUMBER OF BIRTHS, NUMBER OF DEATHS, AND DEATH RATE, BY OCCUPATION OF MOTHER.

Occupation of Mother.	Number of Births.	Corrected Number of Births.	Number of Deaths.	Rate per 1,000 Births.
All Occupations......	802	746	151	202.4
Housekeepers..............	601	567	91	160.5
Gainfully employed........	175	168	51	303.6
Unknown................	26	11	9	—

There can be no question that the infants whose mothers were gainfully employed showed a much higher death rate than those whose mothers were engaged in housework only. Further examination discloses that those gainfully employed were almost entirely mill workers. It has therefore seemed unnecessary to bring into relief the small number of working mothers engaged outside of the mills. It has been impossible to determine from the schedules, with any degree of accuracy, how long before childbirth the employed mothers quit work, or how soon after childbirth work was resumed. We have therefore disregarded these important considerations in our table, illuminating though their analysis would have been.

(f) We are here concerned with the father not so much as a factor in the inheritance of the child, as in his character of a provider who determines the economic conditions of the household. That these conditions play a part in mortality, both during infancy and later, has generally been agreed. The highest death rates are found in the wards of cities where poverty is most common; the converse also holds good. These findings have recently received striking confirmation in the Children's Bureau study of Johnstown. The literature, and especially the German, is replete with trustworthy references to the strong positive correlation between low family income and high infant mortality. For it is the factor of income which determines the number of rooms occupied, their location in the city, the amount and character of the food, the need for supplementary work by the mother outside the home, and other considerations which bear directly upon infant mortality.

Unfortunately the data at our disposal did not lend them-
elves to an investigation of the mortality by amount of
ather's earnings, since a large proportion of the schedules did
not give the wages of the father. It was possible, neverthe-
ess, to get a measure of this item indirectly by analyzing the
ccupations of fathers. A multitude of occupations were, to
e sure, represented, but the largest number of fathers were
ngaged in textile work. There were, for example, 169 mill
peratives, 79 weavers, and 29 doffers and spinners. In all,
here were 360 men employed in the mills. It was thought
afe to combine these into one group for the purpose of our
nalysis. We did not include mill overseers, mill clerks,
rivers of mill teams, etc. In other words, our group was
nade fairly homogeneous in its inclusion of inside mill opera-
ives.

As opposed to them, 400 other fathers, engaged in a number
f varied occupations, were brought together. They included
few professional men, clerks, carpenters, etc. This latter
roup is obviously heterogeneous, including the lowest paid
s well as the best paid men in the community. Although the
ifficulties involved in drawing conclusions from such a con-
rast are obvious, the method will serve its purpose if it does
o more than to indicate the singular condition prevailing
mong textile workers with reference to the mortality of their
nfants.

TABLE VIII.

UMBER OF BIRTHS, CORRECTED NUMBER OF BIRTHS, NUMBER OF DEATHS, AND DEATH RATE, BY OCCUPATION OF FATHER.

Occupation of Father.	Number of Births.	Corrected Number of Births.	Number of Deaths.	Rate per 1,000 Births.
All Occupations	802	746	151	202.4
extile occupations	360	342	69	201.8
ther occupations	400	379	70	184.7
nknown	42	25	12	—

The findings of other observers are again confirmed. There
s a difference of 17 deaths per 1,000 in favor of the infants of
non-textile workers.

Of the 360 men engaged in textile work, the weekly wages were stated in 72 cases. The operatives, of whom there were 34, averaged $10.08, the 17 weavers averaged $10.23, and a number of others averaged $10.67. The average weekly wage for the group of 72 was $10.22. This figure is based on a return of only 20 per cent. of the total cases, and may not be entirely reliable, yet it is doubtless sufficiently accurate as an estimate. The earnings cited show very little variation from the average. They are considerably above the figures for textile workers furnished by the Federal Bureau of the Census and the figures furnished by the Bureau of Labor Statistics of Massachusetts.

It will not take us too far afield in the discussion of economic theory to note that this average weekly wage is too low to maintain a family in good health. It is not surprising, therefore, to find that 98 of the wives of the textile workers were engaged in work outside of their homes; this is 27 per cent. of the total. In only 17 per cent. of the cases in the other group were the wives so occupied. If, as has been shown above, the infant mortality is higher where mothers are engaged in outside work, we have discovered, in the low earnings of the father, one more link in the vicious chain of causes which place the infant mortality of Fall River among the highest in the country.

INCOME TAX STATISTICS.

By Roland P. Falkner, Ph.D., *Statistician, National Civic Federation.*

The adoption of a federal income tax has led students of economics and of public finance to hope for some illuminating material upon the distribution of national income and the operations of the tax. While the results as published in the annual report of the Commissioner of Internal Revenue are worthy of study, they are somewhat of a disappointment. This follows in part from the fact that the system is in its infancy, since the law as a whole affected the income of the year 1913 for ten months only and not the entire year, and since the provisions of the law regarding withholding at the source were operative for the last two months of the year only, and in part from the fact that the information given in the report is somewhat crude in form and meagre in detail.

TABLE I.

INCOME RETURNS FOR 1913.

Incomes for Ten Months, Ending December 31, 1913.		Equivalent Annual Incomes.		
Class in Thousand Dollars.	Number of Returns.	Class in Thousand Dollars.	Number of Thousand Dollars in Each Class.	Number of Income Returns per Thousand Dollars in Each Class.
2½ to 3⅓	79,426	3 to 4	1	79,426
3⅓ to 5	114,484	4 to 6	2	57,242
5 to 10	101,718	6 to 12	6	16,953
10 to 15	26,818	12 to 18	6	4,470
15 to 20	11,977	18 to 24	6	1,995
20 to 25	6,817	24 to 30	6	1,136
25 to 30	4,164	30 to 36	6	694
30 to 40	4,553	36 to 48	12	379
40 to 50	2,427	48 to 60	12	202
50 to 75	2,618	60 to 90	30	87
75 to 100	998	90 to 120	30	33
100 to 150	785	120 to 180	60	13
150 to 200	311	180 to 240	60	5
200 to 250	145	240 to 300	60	2
250 to 300	94	300 to 360	60	1.6
300 to 400	84	360 to 480	120	0.7
400 to 500	44	480 to 600	120	0.4
500 to 1,000	91	600 to 1,200	600	
1,000 and over	44	1,200 and over		

The most general information given in the official report concerns the number of individual incomes for which returns were made.* This is given in a table and chart, the essential features of the table being reproduced in the first two columns of the accompanying Table I. The remaining columns have been added by the writer to bring out the significance of the official figures.

The fact that the returns are for a period of ten months from March 1, 1913, to December 31, 1913,† and not for the calendar year 1913, has been lost sight of in most of the popular discussion of the results. It has, therefore, seemed desirable to add a column showing the annual equivalents for the different income classes given in the table.‡

The table contains a complete showing of all income returns, the obligation to make a return being imposed upon all persons having an annual income of $3,000 and upwards, or who had for the ten months, March to December, 1913, an income of $2,500 or upwards. Since married persons enjoy an exemption of $4,000, the returns include some incomes not subject to taxation. No record of this number is given in the report, information concerning the number of married and "single" persons being given not by classes of income but only for the whole number of returns.

The facts given in the second column as to the number of returns in each income group have been widely published by the press and much surprise has been expressed over the fact that the second group of the table is larger than the first. It has been cited as a very singular phenomenon, quite contrary to our general impressions, that smaller incomes are much more numerous than larger ones. The ingenious explanation

* For the United States as a whole the information is given in a chart and table facing p. 20, for collection districts on pp. 110-111, and for states on pp. 112-113.

† The chart and table facing p. 20 somewhat confuse the matter by referring to the returns as being for the taxable period, March 1 to December 31, 1914.

‡ In transforming the income classes given in the table into their annual equivalents, it has been assumed that the income reported for the ten months was five sixths of the annual income. In view of the fact that the months omitted were those of January and February, 1913, in which fall so many of the payments of interest on securities, it is more than likely that the remaining ten months represent somewhat less than five sixths of the annual income for the year. But as there is no way of estimating with precision the actual difference, we have throughout this paper generally assumed that annual incomes would be one fifth larger than those reported in 1913.

has even been offered that among the smaller income group there may have been an extraordinary amount of tax dodging.

An examination of the table will show that this apparently anomalous statistical fact results merely from the irregular grouping of incomes. If attention be given to the equivalent annual incomes it will be seen that incomes of the first group have a range of $1,000, those of the second of $2,000, and those of the third of $6,000. In the final column of the table here printed is a statement of the number of incomes for each $1,000 included in each group. It will be noted that in this column the distribution of incomes accords better with our general information. Not only is the first group more numerous than the second, but the third group which, in the original statement is nearly as large as the second, becomes only slightly more than one fourth as great.

The misleading impression of the official table is heightened by the accompanying chart. For the purpose of showing how a chart should not be prepared, it is reproduced here for comparison with a chart which gives a clearer view of the distribution of incomes.

A comparison of these general results with the experience of European countries, which have long had income taxes, is tempting but difficult. The British income tax is more complicated in its details than the American tax, and the official returns show the sources of income but do not show the whole number of incomes taxed. From time to time various writers have attempted estimates of the number of persons receiving incomes of a certain size. With the aid of figures drawn from taxes on legacies and on houses, Mr. L. G. Chiozza-Money* has estimated that in 1908–09 there were in the United Kingdom 280,000 persons in receipt of incomes in excess of £700 ($3,406). A comparison with the estimated population shows this number to be equivalent to 625 per 100,000. Though the minimum is higher in this estimate than in the United States the proportion of persons receiving these incomes is notably superior to that which results from our income tax figures. In Continental Europe incomes are taxed directly and the number of taxable incomes is available in the official records.

* Riches and Poverty, 1910.

The exemptions are commonly much less than in the United States and the whole number of incomes taxed cannot therefore be compared with the similar figures here. While statements for certain countries are available by income classes, the divisions used in the foreign figures do not permit an exact comparison. The last edition of Conrad's *Handwörterbuch der Staatswissenschaften* gives a very full statement of income statistics from which some facts may be selected which at least in a rough way may be compared with the figures for the United States. Such figures are given in Table II.

TABLE II.

INCOMES IN FOREIGN COUNTRIES AND THE UNITED STATES COMPARED.

Country.	Year.	Incomes above (Dollars.)	Number.	Population.	Incomes per 100,000 of Population.
France	1907	4,000	64,000	(a) 39,252,267	163
Austria	1907	2,400	25,600	27,729,500	113
German States					
Prussia	1908	2,375	105,000	38,026,556	276
Hamburg	1901	2,500		(b) 768,349	884
Saxony	1906	3,000	12,500	(c) 4,508,601	287
United States (d)	1913	3,000	356,579	96,765,563	368
	1913	4,000	277,499	96,765,563	287

a) 1906. (b) 1900. (c) 1905. (d) Excluding Alaska, Hawaii and Porto Rico.

The lowest income here noted is that which approaches most closely in the respective classifications to the United States minimum. Numbers differ widely according to the size of the countries considered, and reference to the population is necessary. France and Austria present a marked contrast, though the lower limit of incomes referred to is much higher in France, which has the largest proportion of such incomes. Austria, with a minimum income $600 lower than the United States has not even one third as many incomes above the minimum. Comparing incomes above $4,000, France has somewhat more than half as many as the United States. For the German Empire there is no imperial income tax, but such taxes are found in most of the states. The table shows figures for Saxony for the incomes above the $3,000 minimum, which are a little more than three fourths as numerous as in the United States. In Prussia incomes in excess of

$2,400 in round numbers appear to be somewhat less than three fourths as frequent in proportion to the population as are incomes in excess of $3,000 in the United States. Hamburg shows a percentage of incomes above $2,500 much higher than the figures for the United States. This higher percentage is not due to the lower minimum but rather to the fact that Hamburg is a rich city, the centre of the lucrative foreign commerce of the Empire. In the United States no separate figures are published for corresponding city areas, such as New York, Chicago, and Philadelphia. But we shall see later that as high a proportion to the population is found in New York State as a whole as in the city of Hamburg.*

The foregoing comparisons suffer under the fact that for the different countries compared the minimum income for which figures are given differs. This inconvenience can be removed, at the cost however of accuracy of statement, by estimating the number of incomes superior to $3,000 per annum for the purpose of comparing such estimate with the population and with the figures for the United States. In order to make such an estimate all the facts concerning the incomes in these countries were plotted in curves in such way that the height of the ordinate at any given point represented the whole number of reported incomes above that point. The curves for the different countries, with the exception of Saxony where the figure was already known, gave the following estimates of the number of incomes above $3,000 in the various countries, by means of which we have calculated the number per 100,000

Country.	Incomes of $3,000 and over.	
	Number.	Per 100,000 of the Population.
Austria	20,000	59
France	95,000	242
Prussia	75,000	197
Hamburg	——	700
Saxony	12,500	287
United States	356,579	388

* The second and third New York collection districts include the Borough of Manhattan. In these two districts the incomes returned numbered 50,049. If we compare this number with the population of Manhattan Borough, as returned in the Census of 1910, we find the unusual number of 2,142 returns per 100,000 inhabitants. Of course it is to be remembered that the taxes are paid at the principal place of business, and that not all who paid taxes in Manhattan are residents of that Borough.

of the population. In more convenient form this estimate shows the larger number of incomes of $3,000 and upwards which is reported in the United States as compared with all of the countries included in the comparison except the city of Hamburg.

In making these comparisons there is tacit assumption that the incomes reported in the United States are a full and complete indication of the wealth of individuals in this country but there is much reason to doubt whether the total number of returnable incomes actually in existence in the United States found its way into the treasury reports. The system of income taxation is in its infancy and it is more than probable that a considerable number of taxable incomes escaped the tax in the first year of its operation. Under the older and more vigilant administration of the tax in European countries a fuller report of all taxable incomes is probable. In presenting the figures given in Column 2 of Table I, the Secretary of the Treasury makes this comment upon the completeness of the returns:

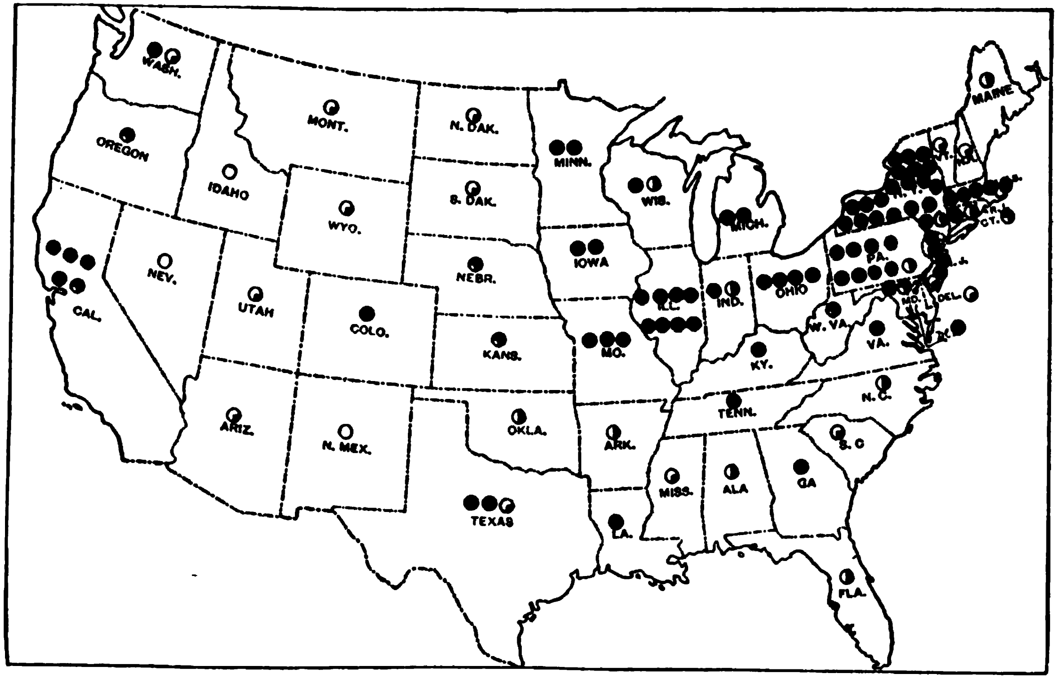
"It is obvious, upon the face of the returns, that there were more than 79,426 persons out of a total population of approximately a hundred million in this country who had net incomes of from $2,500 to $3,333 for 10 months—the taxable period for the calendar year 1913. It may be said with equal truth that there were more than 114,484 people out of our entire population who had a net income of from $3,333 to $5,000, and more than 101,718 people out of our entire population who had a net income of from $5,000 to $10,000 for the same period. It is clear that there were thousands of persons who failed altogether to make a return as required by law."

It will be noted that especial emphasis is laid in this statement upon the lowest income class and indeed a consideration of the figures themselves suggests that the returns in this class are not so full and complete as in the subsequent classes. Incompleteness of the returns, particularly in this class, might be due in part to a desire to evade the tax but it is much more probable that it results in large measure from ignorance of the requirements of the law. The greater number of persons whose income fell in 1913 in the first group—equivalent to

$3,000 to $4,000 per annum—are not in fact subject to taxation because they can claim the benefit of the $4,000 exemption accorded married persons. That such persons are required to make returns although not subject to taxation is not generally known among the public and where it is known such persons are prone to be indifferent about making returns. If we knew how many of the persons who made returns in 1913 were not subject to taxation because of this exemption, we should be able to estimate how far the factor now under consideration had been at work in reducing the whole number of returns.

Returning to the specific information available in the report of the Commissioner of Internal Revenue concerning the incomes in the United States, our attention may first be directed to the geographical distribution of the returns, which is shown by the map accompanying this paper and by the tables which follow. The map shows the income tax returns to be numerous in a group of states extending from Illinois eastward to Massachusetts and in California. Elsewhere returns are comparatively few. When information concerning the income tax returns was first given to the public it received considerable attention in the press. Each newspaper was of course especially interested in its own state, but nearly all of them called attention to the fact that New York State alone had 81,972 returns, or over one fifth of the whole number. In explaining this preponderance, the relation of New York City in the large number of returns to the state was pointed out, but the fact that New York is also the largest state in population was overlooked. The states whose income returns numbered over 10,000 are given in Table III, giving the number of returns for the leading states, and also comparisons with the population.

DISTRIBUTION OF INCOMES SUBJECT TO INCOME TAX



Explanation:—Each dark circle represents 4,000 returns, each quadrant represents 1,000 returns, the last 1,000 being rounded off. Empty circles indicate less than 500 returns.

TABLE III.

NUMBER OF TAX RETURNS FOR INCOMES EQUIVALENT TO $2,000 OR MORE PER ANNUM, BY STATES.

Area.	Returns. All Incomes. Number.	Returns. All Incomes. Per 100,000 of the Population of April 15, 1910. Total.	Returns. All Incomes. Per 100,000 of the Population of April 15, 1910. Urban.	Returns. Incomes of $24,000 and over, Yearly. Number.	Returns. Incomes of $24,000 and over, Yearly. Per 100,000 of the Population of April 15, 1910. Total.	Returns. Incomes of $24,000 and over, Yearly. Per 100,000 of the Population of April 15, 1910. [illegible]
United States (a)	356,579	388	880	23,114	25	54
New York	81,972	900	1,141	7,323	80	102
Pennsylvania	34,225	447	741	2,719	35	50
Illinois	33,342	572	950	1,935	34	56
California	19,567	822	1,222	932	40	63
Massachusetts	19,314	581	618	1,906	57	61
Ohio	16,078	337	628	1,045	22	30
New Jersey	13,346	526	700	783	31	41
Missouri	11,516	350	846	642	19	46
Total for states named	228,550	590	894	17,284	45	67
Other states	128,029	241	704	5,830	11	35

(a) Excluding Alaska, Hawaii, and Porto Rico, from which 1,019 returns were received.

The eight states named in the table contain a little more than two thirds of all incomes returned, but they comprised a little more than four tenths of the population of the country in 1910. In making comparisons with the population the figures of the 1910 census have been used. The utility of such comparisons between different states would not be greatly enhanced by estimating the population of 1913. It may be remarked that for the United States as a whole the ratio of 388 income tax returns per 100,000 of the population of 1910 becomes 368 when the estimated population of 1913 is used. In the group of states here named, the returns per 100,000 inhabitants are more than twice as numerous as in the rest of the country. New York stands at the head of the list in the ratio to the population as well as in absolute numbers, though California follows close behind in the ratio. The order in relation to population does not follow that of absolute numbers.

It cannot fail to be noticed that the states named are those

which contain the largest cities within their limits.* As it is probable that comparatively few of the persons receiving annual incomes of $3,000 and more live in rural communities, it has seemed desirable to establish a further ratio between the number of income tax returns and the urban population which as defined by the census comprises all persons living in communities of 2,500 inhabitants and upwards. Such a comparison shows that relatively the largest number of income tax returns is reported from California and not New York, the smallest number being from Massachusetts. Moreover there is comparatively little difference between this group of states and the rest of the country when ratios are established with the urban population only.

In the foregoing table incomes of $20,000 and over for ten months in 1913, equivalent to annual incomes of $24,000 and over, are shown separately. These are the incomes which in 1913 were subject to the additional tax. They are comparatively few in number, but are more frequent in the states here named than in the remainder of the United States.

The geographical distribution of $3,000 incomes for the different sections of the country, which are familiar in census usage, with ratios to the total and urban population, is shown in Table IV.

*The results of the first assessment make it clear that the income tax is primarily an urban tax. Over 40 per cent. of the entire tax is assessed in Milwaukee city alone, and more than 80 per cent. in the seventeen Counties containing cities. . . . Measured by income there are plainly more persons capable of paying taxes in the city than in the country. . . . 6th Biennial Report of the Wisconsin State Tax Commission (1912), p. 81.

TABLE IV.

NUMBER OF TAX RETURNS FOR INCOMES EQUIVALENT TO $3,000 OR MORE PER ANNUM BY DIVISIONS.

Area.	Returns. All Incomes. Number.	Returns. All Incomes. Per 100,000 of the Population of April 15, 1910. Total.	Returns. All Incomes. Per 100,000 of the Population of April 15, 1910. Urban.	Returns. Incomes of $24,000 Yearly, and over. Number.	Returns. Incomes of $24,000 Yearly, and over. Per 100,000 of the Population of April 15, 1910. Total.	Returns. Incomes of $24,000 Yearly, and over. Per 100,000 of the Population of April 15, 1910. Urban.
United States (a)	356,579	388	860	23,114	26	50
The North	265,898	477	811	[illegible]	35	58
New England	32,277	498	562	2,956	46	54
Middle Atlantic	129,543	671	944	10,525	56	79
East North Central	68,720	480	714	3,996	22	42
West North Central	35,352	342	913	1,421	13	37
The South	55,738	190	842	2,376	8	36
South Atlantic	27,595	265	892	1,211	10	39
East South Central	10,690	142	679	427	5	27
West South Central	17,451	267	892	738	8	38
The West	34,950	512	1,050	1,540	23	46
Mountain	8,048	480	848	322	12	34
Pacific	26,902	1,118	[illegible]	1,218	29	51
East of Mississippi River	268,825	415	808	19,415	30	58
West of Mississippi River	87,754	322	959	3,699	14	40

(a) Excluding Alaska, Hawaii and Porto Rico, from which 1,019 returns were received.

This table confirms with greater detail that which preceded it. Returnable incomes are vastly more numerous in the North than in the South or West. But if reference be had to the total population it appears that relatively North and West have somewhere about the same number of returns, the advantage being for the West. The South falls far below. Quite different is the showing when comparisons are made with the urban population. In this comparison the South as well as the West exceeds the North in the number of returns. There is, however, less divergence among the various sections when the comparison is made with the urban population than when it is made with the general population. The distribution of returnable incomes among the different sections reflects, therefore, the distribution of urban population in those sections.

It may, however, be observed that the larger incomes are

more frequent in the older parts of the country. The largest proportions are found in New England and the Middle States. These divisions, with the Pacific division, are the only ones which exceed the average for the United States and appear in marked contrast to the other parts of the country.

With respect to the persons who pay the income tax, the report gives us the further information that 78,763 are single and 278,835 are married. It is to be remembered that in the income tax law these words have a significance different from that of the census and similar statistics. Under the income tax law the term married is only applicable to a married person who has a wife or husband, as the case may be, living with the person making the return. All other persons, whether bachelors or spinsters, separated, widowed or divorced, are single for the purposes of the income tax law. The "single" persons of the income tax payers are 28 per cent. of the total number, and in the population twenty-five years of age and upward such "single" persons are 26 per cent. of the total. It may also be noted that the 278,835 married persons represent 272,153 households, since 6,682 married women living with their husbands made a separate return of their incomes.

Concerning the income represented by these returns the report gives no definite information, though from the number of incomes and from the product of the tax some approximations may be made. The normal tax of 1 per cent. was levied upon incomes for ten months in 1913, in an aggregate amount of $1,272,803,802. While this is the taxable income it falls short of the true income, first by the amount of the personal exemptions, and second by the income received in the form of dividends. The personal exemptions of $2,500 for 78,760 single persons and of $3,333.33 for 272,152 married persons amounted to $1,104,084,166, which added to the taxable income makes a total of about $2,400,000,000. An additional sum to represent dividend income would have to be added to obtain the total income.

While the figures printed in the report do not give directly the total income, either for the income tax payers as a whole or for any of the different income classes represented in statistics, such information, at least so far as the larger incomes

are concerned, can be derived with the expenditure of no little patience from the figures giving the results of the supertax. The supertax is paid on the entire income and is not subject to deductions either for personal exemptions or for income from dividends. It is paid at varying rates on the excess of total incomes over $20,000. The report of the Commissioner of Internal Revenue gives the product of this tax according to the several rates of taxation, as follows:

Income Class, Thousands of Dollars.	Rate of Taxation. Per Cent.	Tax Collected.
20 to 50	1	$2,934,754
50 to 75	2	1,645,639
75 to 100	3	1,323,023
100 to 250	4	3,835,948
250 to 500	5	2,334,583
500 and over	6	3,437,850
Total		$15,511,797

The combination of the figures here given with those in a previous part of the report in regard to the number of incomes, enables us to analyze each of the several tax classes. Thus taxation at 1 per cent. falls in part on incomes exceeding $20,000 but less than $50,000, and in part on incomes exceeding $50,000. We know the aggregate amount of tax which is paid at the rate of 1 per cent. It is obvious that on all incomes higher than $50,000, the first $30,000 over the untaxed minimum of $20,000 is taxed at 1 per cent. As we know the number of such incomes the amount of the incomes so taxed can be determined and also the amount of the tax upon it. Having ascertained the taxation at 1 per cent. upon all incomes over $50,000, we can deduct this from the total receipts at 1 per cent., to find how much is attributable to the first class, namely $20,000 to $50,000. The amount collected by this taxation multiplied by 100 represents the income which is so taxed.

A similar process can be applied to taxation at the rate of 2, 3, 4, and 5 per cent., respectively, while for the taxation at 6 per cent. no calculation is necessary, as all income above $500,000 is taxed at this uniform rate. The results are shown in Table V.

TABLE V.

ANALYSIS OF ADDITIONAL TAX, SHOWING UPON WHAT INCOMES EACH TAX FALLS.

Line Number.	Tax Class, Thousands of Dollars.	Income Class, Thousands of Dollars.	Number of Incomes Taxed.	Amount of Each Income Higher than the Class Taxed at this Rate.	Tax paid by Each Income Class.	T… In… Ta… Each… at… R…
1	30 to 50 taxed at 1%	30-50	17,961		$1,370,554	$137,
2		50-75	2,618	30,000	785,400	78,
3		75-100	998	30,000	299,400	29,
4		100-250	1,241	30,000	372,300	37,
5		250-500	222	30,000	66,600	6
6		500 and over	135	30,000	40,500	4
7			23,175		2,934,754	293
8	50 to 75 taxed to 2%	50-75	2,618		347,639	17
9		75-100	998	25,000	499,000	24
10		100-250	1,241	25,000	620,500	31
11		[illegible]-500	222	25,000	111,[illegible]	5
12		500 and over	135	25,000	67,500	3
13			5,214		1,645,639	82
14	75 to 100 taxed at 3%	75-100	998		124,523	4
15		100-250	1,241	25,000	930,750	31
16		250-500	222	25,000	166,500	5
17		500 and over	135	25,000	101,250	3
18			2,596		1,323,023	44
19	100 to 250 taxed at 4%	100-250	1,241		1,093,948	43
20		250-500	222	150,000	1,[illegible],000	33
21		500 and over	135	150,000	810,000	20
22			1,598		3,236,948	95
23	250 to 500 taxed at 5%	250-500	222		647,083	12
24		500 and over	135	250,000	1,687,500	33
25			357		2,334,583	46
26	500 and over taxed at 6%	500 and over	135		3,437,850	57

The figures in Table V are given by tax classes. They be rearranged to show the incomes and the tax paid in income class. Such a rearrangement of the material incomes of half a million dollars and over is given in Table

TABLE VI.

INCOMES OF $500,000 AND OVER (135 IN NUMBER).

Taxation Classes, Thousands of Dollars.	Rate of Tax Per Cent.	Portion of Each Income Taxed at Each Rate	Total Income Taxed at Each Rate	Tax paid at Each Rate.
Under 20	0	0	$2,700,000	0
20 to 50 (line 6, Table V)	1	$30,000	4,050,000	$40,500
50 to 75 (line 12, Table V)	2	25,000	3,375,000	67,500
75 to 100 (line 17, Table V)	3	25,000	3,375,000	101,250
100 to 250 (line 21, Table V)	4	150,000	20,250,000	810,000
250 to 500 (line 24, Table V)	5	250,000	33,750,000	1,687,500
500 and over (line 26, Table V)	6	All	57,297,000	3,437,850
			$128,057,500	$6,145,100

Without repeating the component parts of each income class —all the materials are found in Table V—we can gather the following information for total incomes, including the untaxed minimum of $20,000, which are subject to the additional tax.

Income Classes, Thousands of Dollars.	Number.	Income.
20 to 50	17,961	$496,375,000
50 to 75	2,618	148,281,950
75 to 100	998	79,000,767
100 to 250	1,241	166,448,700
250 to 500	222	68,441,660
500 and over	135	128,057,500
Total	23,175	$1,081,608,977

This leaves us with only the incomes from $2,500 to $20,000 to determine. An approximation to the total incomes should be obtainable from the numbers in the different income classes. The average income in each class has been estimated by adding to the minimum an amount equal to one third of the difference between the maximum and the minimum of each class. This estimate allows for the fact already noted that incomes fall off in number as they increase in amount. Whether the allowance is correctly made appears from a comparison of this estimate for figures already given for incomes over $20,000. To permit this comparison and to secure a complete estimate of total income on this basis the estimate is made for all classes, though our special interest at present is in the incomes under $20,000. The results are given in Table VII.

TABLE VII.

NUMBER OF INCOMES AND ESTIMATE OF THEIR AMOUNT.

Income Classes, Thousands of Dollars.	Number of Returns.	Estimated Income.	
		Average.	Total.
2½ to 3½	79,426	$2,778	$220,645,428
3½ to 5	114,484	3,889	445,228,276
5 to 10	101,718	6,667	678,153,906
10 to 15	26,818	11,667	312,885,606
15 to 20	11,977	16,667	199,620,459
20 to 25	6,817	21,667	147,703,939
25 to 30	4,164	26,667	111,041,388
30 to 40	4,553	33,333	151,765,144
40 to 50	2,427	43,333	105,169,191
50 to 75	2,618	58,333	152,715,794
75 to 100	998	83,333	83,166,334
100 to 150	785	116,667	91,583,595
150 to 200	311	166,667	52,833,431
200 to 250	145	216,667	31,416,715
250 to 300	94	266,667	25,066,698
300 to 400	84	333,333	27,999,972
400 to 500	44	433,333	19,066,652
500 to 1,000	91	666,667	60,666,697
1,000 and over	44	$1,500,000	66,000,000
Total	357,598		$2,982,729,225

In applying the method described to the group receiving $1,000,000 and over, which, of course, has no upper limit, it was necessary to assign to this group a purely arbitrary estimate of the average income. The aggregate of incomes under $20,000 appears in this table as $1,856,533,675, while the estimate for the group $20,000 to $500,000 is $999,528,853. The correct figure for the group $20,000 to $500,000 is $958,548,477. We have, therefore, for this large group from $20,000 to $500,000 a direct comparison of actual figures and the estimate, and it appears that the correct figure is 95.9 per cent. of the estimated figure. It seems proper to assume that in the estimate of incomes under $20,000 we have the same excess. Deducting 4.1 per cent. from the estimate of such incomes and adding to the result the correct figures for incomes from $20,000 to $500,000, and for incomes for $500,000 and over, as given in a former table, we have a corrected estimate of an aggregate income of $2,862,021,776 for ten months in 1913, of all persons who had in that period a minimum income of $2,500. From the figures of the normal tax we had already accounted for an income of $2,370,000,000, and if this sum be deducted from

our estimate of the total income it would appear that there is a difference of $490,000,000 to be explained by the income received in the form of dividends, which is not subject to the normal tax. It will be interesting to inquire whether the corporation income tax throws any light upon this subject of dividend income.

Diagram I. Incomes reported 1913 as shown in report of Commissioner of Internal Revenue

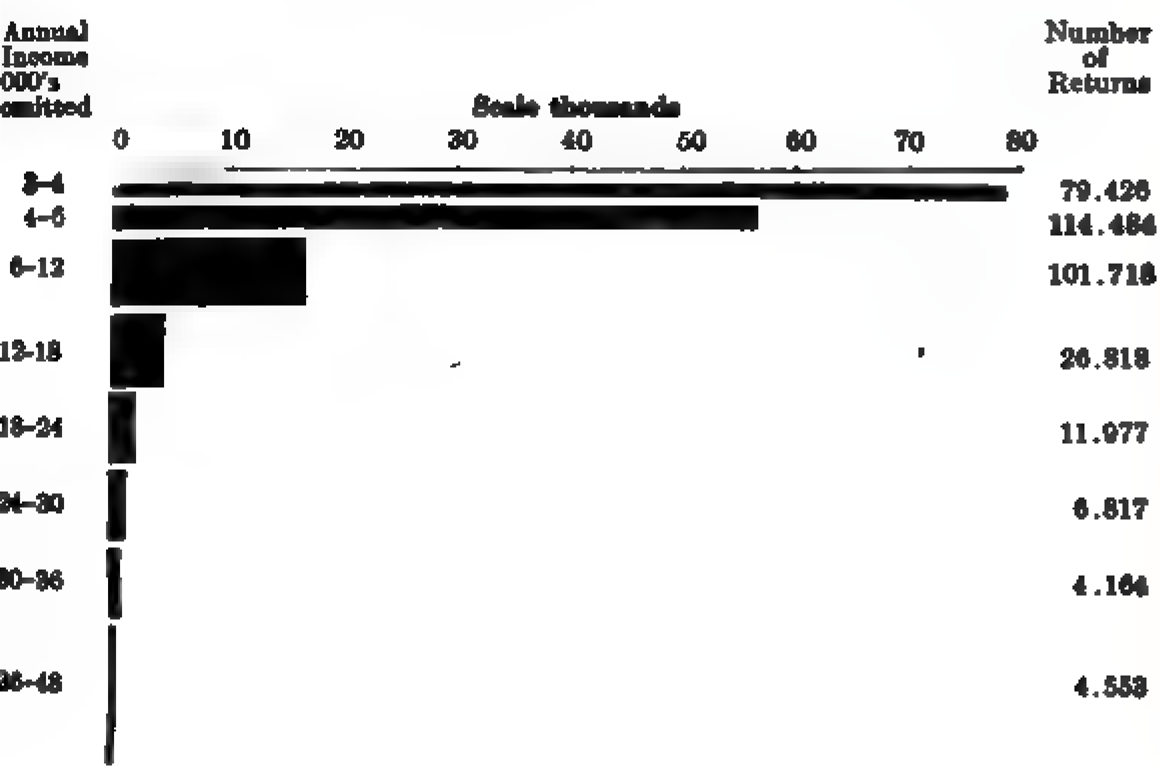


Diagram II. Incomes reported 1913

The tax upon the net income of corporations for ten months of 1913 produced $32,456,662.67. As the tax is 1 per cent., it was therefore levied upon a corporate income of $3,246,000,000. How much of this corporate income was distributed in the form of dividends we have no means of knowing. If dividends averaged only 4 per cent. of the reported capital stock of $64,000,000,000 for all corporations paying taxes, dividend payments would have amounted to $2,640,000,000.* Of course all dividend payments do not become personal income; a large part of it is corporate income of holding companies and to some extent of investing companies, such as savings banks and insurance companies. But it does not seem unlikely that as much as $2,000,000,000 becomes personal income. If this be correct it must be confessed that such income is not fully accounted for in the calculation of personal income which allowed only $490,000,000 for income of this nature to income tax payers. Of course a certain portion of this dividend income goes to persons who are not affected by the income tax, whose annual incomes are less than $3,000, but it seems doubtful whether the greater part goes to such persons.

The foregoing computation necessarily assumes that the figures are correctly reported both for the number of incomes and for the receipts at each tax rate. It would seem unnecessary to mention this assumption were it not for the fact that a closer study of the tables showing the returns of incomes on pages 112 and 113 of the report with the table giving the tax receipts, shows many inconsistencies between the tables. It may be that for the total of the United States the inaccuracies of the tables counterbalance one another and the result which we have obtained can be regarded as substantially correct.

Unfortunately the method of ascertaining incomes which is here indicated cannot be applied to the individual states because of inconsistencies between the two tables which are combined in this operation. Some of the inconsistencies are obvious and some lie below the surface. Some of the most

*In his work on "Income" (New York, 1915), p. 146, Dr. Scott Nearing estimates the dividends paid in 1913 by the corporations reporting to the Commissioner of Internal Revenue as between 2,300 and 2,900 million dollars.

unmistakable discrepancies between the figures are shown in the following comparison of the highest classes which are indicated by the respective tables of the Report of the Commissioner of Internal Revenue:

MAXIMUM INCOMES IN CERTAIN STATES, ACCORDING TO INCOME CLASSES SUBJECT TO ADDITIONAL TAX.

State.	Highest Income.	Group Indicated by.
	Returns of Income (pp. 112–113.)	Receipts from Additional Tax (pp. 192–193.)
District of Columbia	$250,000 to $500,000	$500,000 and over
Florida	75,000 to 100,000	500,000 and over
Georgia	100,000 to 250,000	500,000 and over
Indiana	250,000 to 500,000	500,000 and over
Nevada	20,000 to 50,000	[illegible]
Alaska	50,000 to 75,000	20,000 to 50,000
Arizona	100,000 to 250,000	20,000 to 50,000
Idaho	100,000 to 250,000	Under 20,000
Mississippi	100,000 to 250,000	75,000 to 100,000
Montana	75,000 to 100,000	Under 20,000
North Dakota	75,000 to 100,000	50,000 to 75,000
Utah	[illegible] to [illegible]	Under 20,000
Washington	250,000 to 400,000	20,000 to 50,000
Wyoming	100,000 to 250,000	Under 20,000

But there are other discrepancies which are not so obvious and which would be revealed only by an examination of each state. Thus for North Carolina the table on page 112 reports 2 incomes between $250,000 and $500,000. The additional taxation upon these 2 incomes would be as follows: At 1 per cent., $600; at 2 per cent., $1,000; at 3 per cent., $1,500; and at 4 per cent., $12,000. But the actual receipts reported from all incomes in North Carolina at the rates of 2, 3, and 4 per cent., respectively, were less than the sums here named. Again, in Michigan we find 15 incomes reported as exceeding $250,000. Taxation at 4 per cent. falls on that part of such incomes which is above $100,000 and below $250,000, which, at $6,000 for each income, should give tax receipts of $90,000 for the 15 incomes to which reference has been made, without any consideration of other incomes which may fall between $100,000 and $250,000. But the receipts returned at 4 per cent. in the state of Michigan amount to only $85,228.

There is no clue in the report of the Commissioner of Internal Revenue as to the cause of these discrepancies. The suggestion naturally occurs that in some cases the taxes are in arrears and such an explanation would cover a number of discrepancies which have been noted, but not all of them. It would not, for instance, explain that in the state of Nevada a tax has actually been paid upon an income which can be estimated at $256,000, while no income higher than $40,000 appears in the tabulation of returns. Moreover there is no suggestion in the report of the treasury officials that any considerable proportion of the income tax is in arrears. According to the best information which I can obtain on the subject the discrepancies between the tables are due to the fact that they have been made by different sets of clerks, and that no effort has been made to check them one against the other. It also appears that classifications have been made at different periods of the year and that some of the discrepancies may be due to changes in the classifications which had taken place as a result of the activities of the treasury department.*

In view of the discrepancies to which attention has been called, we may well hesitate to attempt to ascertain the amount of incomes for any lesser areas than for the whole United States. With the exception of the state of New York, of which it forms a part, the Borough of Manhattan with its 50,000 taxable incomes is the largest group in the United States. The number is probably large enough to render of comparatively little significance the idiosyncrasies of the tables to which we have referred. Subject to these reservations we can, therefore, ascertain for the Borough of Manhattan the dis-

* The matter herein referred to was submitted to the Commissioner of Internal Revenue, who, under date of April 5, 1915, replied concerning the discrepancies which have been noted in part as follows:

"In reply you are advised that the table on pages 112-113 shows the correct classifications, numerically by states, and was compiled by this office from the individual returns themselves.

"The receipts shown in the table on pages 192-193, both items by states and totals, represent the actual collections for the fiscal year ended June 30, 1914, verified by this office as of that date. The classifications of income shown in this table, however, are based on the reports of Collectors of Internal Revenue from the facts before them at the time of their reports; and the exigencies of administration will not permit the office, at the present time, to trace the various changes that have since been made, or that have been required to be made, in individual returns as originally rendered."

One cannot feel that the explanation is subject to any other interpretation than that given in the text. While the writer asserts in the first paragraph that the table on pages 112 and 113 shows the correct classifications because they were compiled in the central office, one cannot feel complete assurance of this fact when we have a record of receipts on incomes higher than any of those named in the classification. The correspondence admits the discrepancies and does not, I feel, offer any explanation of their cause.

tribution of incomes represented by the returns. This is shown in Table VIII.

TABLE VIII.

INCOME TAX PAYERS AND INCOMES—BOROUGH OF MANHATTAN.

Income Classes, Thousands of Dollars.	Tax Payers.		Incomes.	
	Number.	Per Cent. of U. S. Total.	Total.	Per Cent. of U. S. Total.
2.5 to 20	44,481	13.3	$260,152,196 (a)	14.6(a)
20 to 50	4,058	22.5	109,592,400	22.1
50 to 75	697	26.5	37,802,233	25.5
75 to 100	293	29.4	26,306,233	33.8
100 to 250	353	25.4	46,287,825	27.8
250 to 500	91	41.0	26,170,100	33.9
500 and over	76	56.3	96,779,417	78.6
20 and over	5,568	23.6	342,940,025	31.7
Total	50,049	14.0	603,092,221(b)	21.0(b)

(a) Estimated. (b) Partly estimated.

It will be noted that while Manhattan has 14 per cent. of all the taxpayers, the income which they represent is 21 per cent. of the total estimated income in the United States. Generally speaking, the share attributable to Manhattan grows as the incomes become larger. The reader will not fail to observe that more than half of all the incomes of $500,000 and over are in Manhattan and that the income which they represent is more than three fourths of all the income of this class in the United States.

It would fall short of a complete analysis of the available figures were we to neglect the fiscal aspects of the tax. Besides considerations affecting the distribution of incomes there are others which are derivable from the report, and concern the weight of taxation, its geographical distribution, and its future fruitfulness, which may well engage our attention.

In a taxation system as composite as the income tax with its exemptions and graduated rates, there is an interest in ascertaining the total weight of the tax with reference to the total income. The total product of the tax in 1913 was $28,253,534, and this was levied according to our calculations upon a total

income of $2,862,021,776. Disregarding all exemptions, therefore, the taxes paid both as normal and as additional tax amounted to approximately 1 per cent. (0.98) of the total income of persons subject to income taxation. In the aggregate the normal tax was equivalent to 0.44 per cent. of the total income as computed. In view of the progressive taxation of the supertax, it would be desirable to carry out calculations similar to those indicated for each income class. Such a problem offers considerable difficulty on account of the scanty material at our disposal, regarding the normal tax. For the additional tax, however, exact information is available. Table IX exhibits the amount of additional tax paid by each income class and the resulting rate of taxation.

TABLE IX.

INCOMES OF $20,000 OR MORE AND ADDITIONAL TAX PAID.

Income Class Thousands.	Incomes.		Additional Tax Paid.	
	Number.	Amount.	Amount.	Per Cent. of Total Income.
20 to 50	17,961	$496,375,400	$1,370,554	0.28
50 to 75	2,618	148,281,950	1,133,039	0.76
75 to 100	998	79,000,767	922,923	1.17
100 to 250	1,241	166,448,700	3,617,498	2.17
250 to 500	222	68,441,660	2,323,683	3.39
500 and over	135	123,057,500	6,145,100	4.13
Total	23,175	$1,081,605,977	$15,511,797	1.43

Our table compares the total additional tax paid with the total income of the persons subject to such tax and not with their taxable income alone. While incomes of over $500,000 are subject to an additional tax of 6 per cent., this rate applies to the excess over $500,000—not to the total income. A person enjoying an income in excess of $500,000 pays his additional tax in the manner shown in Table VI, namely, no additional tax on $20,000, 1 per cent. on the next $30,000, 2 per cent. on the next $25,000, 3 per cent. on the next $25,000, 4 per cent. on the next $150,000, 5 per cent. on the next $250,000, and 6 per cent. on all beyond that, or beyond $500,000. A person therefore with an income of $600,000 would pay additional taxes to the amount of $26,050, equiv-

alent to 4.34 per cent. of his entire income. His total tax would be increased by the normal tax which by reason of the personal exemption and the omission of incomes, if any, from dividends, would be somewhat less than 1 per cent. His total taxation, if he were married and had no income whatever from dividends, would be 5.33 per cent. of his total income, while if we could assume the extreme case that all his income arose from dividends, his total taxation and his additional taxation would be identical, namely, 4.34 per cent. of his total income. Table IX refers to the additional tax only, and shows that it increases from an average of 0.28 per cent. on the incomes over $20,000 and less than $50,000, to 4.13 per cent. for the highest income class.

While we know that the normal tax averages 0.44 per cent. of total income of all classes, we cannot add this figure to the rates above calculated for the additional tax in the several income classes, to determine total taxation in each class. There are no figures given in the official documents showing receipts from normal tax by income classes, nor can these figures be calculated with any degree of precision. We could indeed estimate the distribution of income below the tax limit for normal taxation with a slight degree of error. For if we assume that the married and unmarried taxpayers are evenly distributed among the different income classes, we have only to distribute the exempted income (p. 532) in proportion to the number of taxpayers in each class. If we should deduct the personal exemptions, so estimated, from the aggregate income of each tax class as computed or estimated in the earlier part of this paper, we should have a series of figures from which we could derive the proportion of the normal tax receipts attributable to each tax class, always, be it noted, under the assumption that dividend income is distributed among the different classes in the same proportion as other income. By such a calculation we reach the tentative result that incomes under $20,000 paid $5,409,000 normal tax and incomes above that sum $7,319,000. If such were the receipts they were equivalent to a tax of 0.30 per cent. on total income of persons with less than $20,000, and 0.68 per cent. on total income of persons with larger incomes. But these results

would doubtless be changed if we knew anything about the distribution of dividend income. If dividend income is more frequently a constituent part of larger than of smaller incomes, then the amount of normal tax paid by incomes under $20,000 would be greater than the sum given above and the average rate of taxation would be also greater, while the converse would be true as respects incomes over $20,000. How large the change might be it would be hazardous to estimate. The possible limits can be, however, pointed out. If there were absolutely no dividend income received by persons having less than $20,000 income, the normal tax paid by such persons would have been $7,478,763 or 0.42 per cent. of the total income of this class. And if all the dividend income belonged to those whose incomes exceeded $20,000, their normal tax would have been $5,249,275 or 0.48 per cent. of the total income of this class. It is clear that whatever the distribution of dividend incomes, as between these two groups, the normal tax would always form a larger percentage of the total income of the group with higher incomes, than of the group with lower incomes.

The conclusion seems to be warranted that for incomes of less than $20,000 the total taxation which is all normal tax probably does not exceed four tenths of 1 per cent. of the total income of this group. It is further clear that to the rates for the additional tax shown in Table IX for incomes of $20,000 and over, there must be added for the normal tax a figure which is somewhere between 0.45 and 0.65 per cent. of the total income, if we are to ascertain the total rate of income taxation for these classes.

If for reasons already stated we must forego an attempt to compare geographically the number of incomes with the amount of such income, the tax receipts throw some light upon how far the distribution of income by numbers differs from that by amounts. In Tables X and XI figures are given for the amount of tax receipts, both for the normal tax and the additional tax, with relative figures showing also the distribution of taxable incomes, for the same geographical areas as figured in our previous tables.

TABLE X.

INCOMES AND TAX RECEIPTS BY LEADING STATES, 1913.

Area.	Incomes Subject to Normal Tax.			Incomes Subject to Supertax.		
	Tax Paid.	Per Cent. Distribution.		Tax Paid.	Per Cent. Distribution.	
		Tax Paid.	Number of Incomes. See Table III.		Tax Paid.	Number of Incomes. See Table III.
United States	$12,711,050	100.0	100.0	$15,505,232	100.0	100.0
New York	5,445,937	42.8	22.9	7,076,860	45.6	31.7
Pennsylvania	1,243,747	9.8	9.5	1,932,348	12.5	11.8
Illinois	880,028	6.9	9.0	1,196,143	7.7	8.4
California	494,761	3.9	5.4	385,613	2.5	4.0
Massachusetts	670,313	5.3	5.4	835,573	5.4	8.2
Ohio	354,511	2.8	4.5	549,997	3.5	4.5
New Jersey	338,565	2.7	3.7	378,191	2.4	3.4
Missouri	287,876	2.3	3.3	369,182	2.4	2.8
Total	9,715,738	76.4	64.1	12,723,907	82.1	74.8
Other states	2,995,322	23.6	35.9	2,781,325	17.6	25.2

TABLE XI.

INCOMES AND TAX RECEIPTS BY GEOGRAPHICAL DIVISIONS, 1913.

Area.	Incomes Subject to Normal Tax.			Incomes Subject to Supertax.		
	Tax Paid.	Per Cent. Distribution.		Tax Paid.	Per Cent. Distribution.	
		Tax Paid.	Number of Incomes. See Table IV.		Tax Paid.	Number of Incomes. See Table IV.
United States	$12,711,050	100.0	100.0	$15,505,232	100.0	100.0
The North	10,506,759	82.7	74.5	14,093,115	90.9	83.1
New England	1,020,403	8.3	9.0	1,432,973	9.2	12.8
Middle Atlantic	7,028,249	55.3	36.3	9,387,399	60.5	46.8
East North Central	1,778,710	14.0	19.2	2,621,603	16.9	17.3
West North Central	679,397	5.3	9.9	651,140	4.2	6.1
The South	1,389,525	10.9	15.6	881,661	5.7	10.3
South Atlantic	700,738	5.5	7.7	626,980	4.0	5.2
East South Central	225,242	1.8	2.9	73,883	.5	1.8
West South Central	463,545	3.6	4.8	180,798	1.2	3.2
The West	814,766	6.4	9.8	530,456	3.4	6.7
Mountain	182,308	1.4	2.2	70,011	.5	1.4
Pacific	632,458	5.0	7.5	460,445	3.0	5.3
East of Mississippi River	10,753,342	84.6	75.4	14,142,838	91.2	84.0
West of Mississippi River	1,957,708	15.4	24.6	1,362,394	8.8	16.0

Table X shows that New York and Pennsylvania, of all the states named, pay a larger proportion of the normal tax than their proportion of the total number of incomes. This points, of course, to larger average incomes than elsewhere. In like manner these two states pay a larger percentage of the supertax than their share of the number of incomes subject to such tax. It is, however, both as respects normal tax as well as supertax, only in the case of New York that the discrepancy is marked.

Table XI showing geographical divisions, emphasizes the fact that tax receipts not only for the normal tax but especially for the additional tax, are more concentrated in the North, and particularly in the Middle Atlantic section, than are the incomes subject to taxation.

The total receipts for the first ten months' experience in the tax were, as has already been stated, upwards of $28,000,000. It may be noted that for the year 1914 the Secretary of the Treasury estimates the receipts from the personal income tax at $40,000,000. At the first blush it might seem that the estimated increase was somewhat excessive but there are several factors which enter into the probabilities of the case. Some of them are indicated by the Secretary of the Treasury, and others are not mentioned though doubtless they contributed towards forming his judgment of the probable income.

There are at least six factors which would lead us to anticipate greater receipts from the personal income tax in 1914 than in 1913:

1. The tax in 1914 will affect the whole year's income and this in itself would account for an addition of one fifth to the receipts were no other persons taxed than those who made returns in 1913.

2. The returns for 1914 will include the income for January and February of that year, months which were omitted in 1913 and also months in which certain kinds of income, especially receipts from interest upon securities, are abnormally heavy.

3. The system of taxation at the source will be in full vigor in 1914. Apart from the fact that this may lead to a more ac-

curate ascertainment of incomes, there can be no doubt that such taxation at the source will affect the incomes of persons not really subject to taxation because of the failure of large numbers of persons who are receiving income in comparatively small quantities from interest on securities to make the necessary declarations of exemption.

4. With the natural growth of population, other things being equal, a larger number of persons would probably be subject to the income tax in 1914 than in 1913.

5. The tax for 1914 will probably be levied more fully than in 1913 and the evasions of the tax, either through willful tax dodging or through ignorance of the law, will be less frequent.

6. As the incomes for the year will be larger, they will, so far as the additional tax is concerned, often be subject to taxation at higher rates. Thus a person whose income in 1913 was exactly $20,000 was not subject to the additional tax, but his income for 1914 will be at least $24,000 and the excess over $20,000 will be taxable at 1 per cent.

As a partial offset to these various factors which will tend to increase the productivity of the income tax in 1914 as compared with 1913, we must take into account the fact that the general condition of business was less prosperous in 1914 than in 1913. That this element will have some effect can hardly be doubted although the extent of its influence is not susceptible of measurement.

From the meagre and incomplete figures which we have attempted to analyze in this paper, the most obvious conclusion is the need for far more complete information in regard to incomes and the income tax than we now possess. Returns for the year 1914 are now in the hands of the internal revenue officials. Let us hope that next year the Commissioner of Internal Revenue will tell us what these returns really contain. The system of taxation at the source will be in full vigor and new and interesting questions will arise which can only be answered by a much more detailed analysis of the figures. There seems to be no reason why the public should not know for each income class not only the number of persons included in it, but also how many are single, how many are married, what is the amount of exempted income, what the amount of

dividend income, what the amount taxed at the source, the amount of taxable income and the product of the tax. Such an analysis would be easily derivable from the income tax returns. If the information given is to be valuable, considerable attention must be given to taxation at the source, and salary payments should be distinguished from interest payments. If this is done we should be able to distinguish income from salaries and similar sources, that from dividends and that from interest. Furthermore it would seem a comparatively simple thing to ascertain revenues from business undertakings.

There are also some special questions on which the public is entitled to information. One of them concerns particularly the income received from dividends. Such an analysis of the net income of corporations as would show how much of this income is distributed in the form of dividends, is highly desirable. It is also important to ascertain how much of such dividend income goes to other corporations and is taxed again through their income tax, and how much of it goes to individuals. If the latter point were ascertained and the declarations of the individual income tax properly tabulated, we should be able to see how much of the tax on the dividends falls upon those persons who are liable to income taxation, and how much falls upon persons who are not so liable, either because their income is less than $3,000 per annum or because they are educational and other institutions exempted from the payment of the tax. A further question which will be of particular interest in the coming year, when the system of taxation at the source is in full swing, relates to the payment of interest by corporations. Under the law the tax on such interest must be paid at the source unless there is filed for the individual recipients declarations of exemption. It is undoubtedly a fact that a considerable number of holders of small amounts will not file such notices of exemption and that consequently so far as the interest on the securities is concerned it will really be paid for persons who are not subject to the personal income tax. If the amount of tax paid at the source by corporations should be compared with the aggregate interest noted in the individual returns as taxed at the source, we

should then be able to ascertain how far the former exceeded the latter.

These are simple illustrations of the kind of information which could be derived from the income tax returns if they were properly systematized and presented to the public. They are in fact a veritable mine of economic information, but it is a mine which needs to be worked. Surely the government must have at its disposal the advice of expert economists and statisticians who could show what facts ought to be presented to the public, and how the material should be analyzed to obtain such information. Unless appearances are misleading, the Commissioner of Internal Revenue did not seek such advice in preparing his first report. With a full year's returns for 1914, and with the system in complete operation, it is to be hoped that these problems will receive more adequate attention.

OLD AGE AND THE INDUSTRIAL SCRAP-HEAP.

By Arthur J. Todd, *University of Pittsburgh.*

The problem of "dead weight" in a population is one of the most delicate questions in the whole range of social economy. Statisticians commonly reckon as dead weight, or *bouches inutiles,* children under 15 and adults over 60. National morality, no less than national productive capacity, is to be measured by the general treatment accorded these age groups. Primitive men settled the matter rather summarily by infanticide, killing off the aged, or "reasoned neglect." Andrew Lang once described in his own inimitable way how some savages used to put their old gentlemen up in trees, and then after singing "the fruit is ripe!" shook the trees and clubbed the aged unfortunates as they tumbled down. Incidentally he expressed the hope that America would not revive the custom!

The storm of indignant protest which greeted Dr. Osler's Johns Hopkins address indicated that we are by no means ready to grant that men have outlived their comparative usefulness at 40, or have become utterly useless above 60. Trollope's earlier sentence of painless extinction for the elderly person was repudiated no less roundly. And that the protests were not mere spasms of sentimentality is proved by the stores of facts brought forth to show what the world would have lost in nearly every field of human activity had the Osler suggestion been taken seriously. Dexter, for instance, showed that eminence in twenty fields was reached only at a median age of 54. The average distribution of all persons below 40 in a company of 6,983 *Who's Who* eminences footed up only some 16 per cent. There is little doubt that longevity is increasing; we have good reason to believe that the average lease of life has doubled in the last three hundred years. But that is not all: The level of old age also is rising. Doctor Johnson suggested 35 as the point after which a man's steps turn down hill; and Montaigne retired at that age to meditate as became

an elderly gentleman. Both Dante and Sir Walter Scott spoke of old age coming at 55. But on the other hand Sir James Crichton Browne tells us that life owes every man and woman a hundred years, and that it is their business to see that they collect the debt. And William James hinted at the true definition of old age when he declared that one might become an old fogey at 25, but went on to do perhaps his own most significant work after 60.

The more specific problem in hand is, What evidence exists of a generally recognized upper age limit of economic efficiency? This is the substance of the oft-repeated question, What becomes of the worker over 50? Is there any evidence that modern industry is "scrapping" its workers at an unduly early age, or is using them up any more rapidly than formerly? And if industry finishes with them, say, at fifty or sixty, what becomes of the wreckage?

It must be admitted at the outset that the materials for answering these questions are widely scattered, and not by any means always satisfactory. Several statistical difficulties intervene. In the first place, there is a tendency to misrepresent ages either by under or over-statement, according to some fancied possible advantage. It is significant for our problem that more persons return themselves as younger than as older than they are. There is also liability to error in reporting persons as occupied or unoccupied. A man of 65 may report himself as occupied when in reality his employment may be of the most casual sort; he may be underemployed or sweated, and his earnings may be quite insufficient for his maintenance. Again, Census reports give only the sparsest details, too few for full comparison. And special studies like Booth's of London or Rowntree's of York are fragmentary or limited in area and time. Also increasing longevity complicates the problem and makes statistical comparisons difficult.

According to the Census of 1910 the male population of the United States above the age of 50 totalled 6,770,392, distributed as follows: Age 50–60, 3,598,450, or about 53 per cent.; age 60–70, 2,049,960, or about 30 per cent.; age 70 and above, 1,121,982, or 17 per cent. If we compare the numbers

in the several age groups with the total population it appears that age 50–60 contains 7.2 per cent. of the total population; age 60–70, 4.3 per cent.; age 70 and over, 2.3 per cent.

The economic status of these age groups is hard to discover from census returns. We know, however, that a considerable plurality of the population 45–64 live in the country, either as farm owners, tenants, or laborers; that a still larger proportion of those 65 and over are rural dwellers; moreover, that the owners of farms quite overtop tenants in the ages 55 and over. The lower rural death rate would account in part for the accumulation of the aged in country areas; but there is usually also a certain tendency for the worker caught in the modern city-ward drift to seek the country again in his old age. From statistical estimates occasioned by social insurance and pension proposals some further ideas may be gleaned. Congressman Berger in his speech before the House, 1911, declared that a pension scheme for needy persons over 60 would have to reckon on 2,675,000 individuals; but there seems to be no sound evidence for quite so high a figure. F. L. Hoffman, a keen critic of old age pension schemes, estimated in 1908 that 1,786,161 persons over 60 would be entitled to pensions. L. W. Squier stated in 1912 that approximately 1,250,000 former wage earners 65 and over are in want and supported by public or private charity. The Massachusetts Commission on Old Age Pensions (1910) found in that state alone about 12,000 persons 65 and over, exclusive of public paupers, eligible for pensions. The figures run somewhat higher for England. Hence the presumption that for some reason or other a large number of persons over 60 years of age are more or less dependent.

Only a small part of them are in charitable institutions. The special census report on paupers in almshouses in 1904 accounted (on December 1, 1913) for only 37,143 males over 50, of whom 28,075 were over 60. It revealed, however, that the average age admission of all males was 51 years. A similar census report for 1910 enumerated 43,101 males over 50, of whom 31,179 were over 60. While the general almshouse pauper rate has steadily declined for the last thirty

years (from 1,320 per million of the population in 1880 to 915 per million in 1910), the increase in age groups 55–80 has been marked during the last ten years. This increase is not necessarily due to admissions out of proportion to the general increase in population; it may result in part from an accumulation of the higher ages through increasing longevity—a phenomenon accountable also in part for the apparent increase in the rate of insanity. Between 1904 and 1910 the almshouses added 13.4 per cent. to their numbers aged 55–80: men increased 18 per cent., women 7 per cent. Comparing the numbers admitted during the census year, it appears that the totals for 1910 exceeded those of 1904, ages 55–80, by 12 per cent.: men increased 17 per cent., women fell off 7 per cent. Lest these figures gather undue significance, let us hasten to add that the decennium 1900–1910 swelled the general population by nearly 2,000,000 persons between 55 and 80, a gain of 27 per cent. Only a trifle over 1 per cent. of the total population over 65, and considerably less than 1 per cent. of those 55 and over, are in public almshouses. Hence it is obvious that if dependence is on the increase in these age groups it is being cared for outside the public almshouses.

If we turn to the census reports on private "permanent homes" presumably for the aged, the number of male inmates shows an increase from 54,800 in 1904 to 59,677 in 1910. This gain is not proportionate to the increase in the general population in its higher age groups. It may very well be that the United States is sadly deficient in institutional homes for the aged respectable poor, or for those with slender incomes. For in spite of the fact that such homes increased by nearly 20 per cent. in the last decade, it is still true that after deducting the inmates of Soldiers' Homes, private charitable homes in 1910 were caring for only 22,094 men, presumably superannuated.

Nor do institutions for the care of insane and feeble-minded indicate any striking increase in the care of aged defectives. In 1904, 32,995 males over 50 were found in insane hospitals; in 1910 the numbers rose to 34,999, an increase of about 6 per cent. as compared with a gain of over 28 per cent. in the

general population aged over 50. As to the feeble-minded over 50, their numbers are quite negligible, a bare 250 for the country as a whole. Perhaps not more than 2 per cent. of all the institutionalized feeble-minded run over 50. Even assuming that only one tenth of this class of dependents are institutionalized, their total in the general population is not formidable. And, indeed, this whole class is more or less negligible when one is considering the fate of the normal superannuated worker. For at best the feeble-minded man occupies only the most casual place in the industrial mechanism.

Among tramps the larger proportion are under 50, perhaps even under 30. But a considerable number of so-called "homeless men" are over 50, if we can judge by Mrs. Solenberger's study of a thousand typical representatives of this class; and most of them, whatever their original trouble, gravitate to the cheap lodging houses of large cities.

The charitable agencies account for another superannuated group. From the records of Charity Organization Societies in the United States the factor of old age as a determining cause of poverty seems to run from 3 to 6 per cent., as compared with nearly 30 per cent. for certain sections of London, and about 15 per cent. for some 76 German cities. But as the American figures do not include cases of unemployment due to old age, the discrepancy may not be so large as might at first appear. Miss Goodyear's study of 5,000 dependent New York City families developed the fact that nearly 12 per cent. had heads 60 years old and over.

No definite figures can be cited to show the sources of income for these more or less dependent families and elderly individuals. A comparatively small number, as we have already indicated, are housed in various types of public or private institutions. Some live off their accumulated savings. But their number must be relatively small, for three reasons. First, admitting the optimistic claim that real wages have increased in the last two or three decades, it is quite probable that the increase has gone to the bettering of living conditions rather than into savings. Second, statistical studies of workingmen's budgets show a striking lack of income-surplus which might be con-

verted into savings accounts or old-age annuities. Mrs. More's figures covering 200 New York families in 1907 showed a substantial surplus only when the income exceeded $1,000. But as only about one tenth of American wage workers earn over $1,000 a year, Rubinow is apparently quite within the truth when he concludes that a surplus of $50 per annum is not at all a common occurrence among wage-earners. Third, such meagre studies of savings banks as we have confirm these conclusions. In typical Massachusetts savings banks within reasonably recent times the average deposit of working people was less than $75. Rubinow's analysis of Connecticut savings banks does not tell a substantially different story. These banks show a 300 per cent. increase in total deposits and a 200 per cent. increase in depositors during the last thirty years. But since 85.3 per cent. of all depositors had less than $1,000 each (and unless the figures for 1880 have changed miraculously, three quarters of this group averaged less than $500 each), and since only one third of the total deposits were held by the small-depositor group, it may well be that workingmen's deposits represent only one third of the total. As a matter of fact their average deposit seems to have increased from $190 in 1880 to $202 in 1910, a gain of 7 per cent. as compared with an increase of 22.9 per cent. in the average deposit of the so-called richer groups. From the standpoint of sharing in the total increase of deposits it must further be noted that while the total number of depositors in general hardly tripled, the number of those having accounts over $2,000 more than quintupled. Or, stated otherwise, during the thirty years in question the group of smaller depositors dropped from 46.5 per cent. to 37.5 per cent., while the larger depositors rose from 19.9 per cent. to 37.5 per cent. of the total. Hence on the whole we get little encouragement from savings bank returns. And there is little evidence at hand of any very wide use of the "stocking" or the "chimney" as a hoarding place outside the banks.*

* Returns from the United States Postal Savings Banks bear out this general conclusion. Notwithstanding the recent large increase in deposits and depositors, due in part to the cessation of remittances to Europe brought about by the war, the average deposit on Jan. 1, 1915, was only $119.

Private charity and public out-door relief constantly take care of many thousands of the aged poor; but exactly how many nobody knows. Squier, using Massachusetts figures as a basis of computation, estimates the number at about 150,000. We are on somewhat surer ground in estimating aged United States pensioners. According to the report of the Commissioner of Pensions for 1914, pension claims up to June 30, 1913, under the Act of 1912, were admitted from 395,750 survivors of the Mexican and Civil Wars. Their ages ranged from 62 to 103, with an average of 70.7 years. 8.1 per cent. were between 62–65; 34.7 per cent., 66–69; 35.7 per cent., 70–74; 21.5 per cent., 75 and over. These figures practically exhaust this class of military pensioners.

Various other types of public or private pensions granted by municipalities and by perhaps fifty notable industrial and transportation corporations ease the lives of several thousands of those whom old Fuller quaintly called "industries martyrs." A favored few have been able to save enough to buy annuities. Some, comparatively few, however, receive trade union superannuation benefits. A large number depend upon relatives and family friends.

Perhaps all except the well-to-do, the lazy, and the incapacitated add by their own labor to these rather slender sources of income. The census returns for both England and the United States tell something of the employments of the elderly. Out of every 100 males in gainful occupations at the United States Census of 1890, 13.5 were aged 45–54; 8 aged 55–64; 5.3 aged 65 and over. Between ages 20–65 more than nine tenths were employed; and even after 65 nearly three quarters reported themselves as occupied. But from 1890 to 1900 in every age group above 25 the proportion of males gainfully occupied dropped. In 1890, 96.6 out of every 100 males aged 45–54 were occupied; in 1900, only 95.5. Ages 55–64 dropped from 92.9 to 90 out of the hundred; ages 65 and over, from 73.8 to 68.4. The Census of 1910 is exceedingly unsatisfactory on this point: It gives no age classification over 45. The only information we can glean from its slender tables is to the effect that in 1900, 87.9 per cent. of all males over 45 were employed, while in 1910 only 85.9 per cent. returned

themselves as gainfully occupied. English experience seems parallel. The proportion of all persons over 65 gainfully employed fell from 64.8 per cent. in 1891 to 60.6 in 1901.

The United Census further shows that some kinds of elderly persons are better off than others. Foreign born whites over 55 showed a much smaller percentage at work than native white or native parentage in the same age groups. And negroes work to higher ages than any other class, probably because few of them acquire a competence enabling them to give up work as they approach old age, and because of their traditional horror of the poor-house. The foreign born utilize relatives and other sources of relief probably somewhat earlier than the native; among them, too, the habit of mutual aid societies and other coöperative relief agencies is stronger than with the native American.

The type of occupation claiming aged workers is of considerable significance. At the Twelfth Census, of all workers aged 45–54, more than 40 per cent. were in agriculture; 4 per cent. in the professions; 13.6 per cent. in domestic and personal service; 17 per cent. in trade and transportation; and 24.9 per cent. in manufacturing and mechanical industries. At ages 55 to 65 and above, the proportion of agriculture increases strongly; the professions slightly; while in each of the other occupations the numbers drop considerably. Stated in another way, it appears that workers 55 and over constituted 15 per cent. of all those engaged in agriculture, 15 per cent. in the professions, 10.5 per cent. in domestic and personal service, 9.5 per cent. in trade and transportation, and 10.6 per cent. in manufacturing and mechanical industries. While it thus appears that a considerable proportion of workers of the upper age groups still hold their places in industry, it must be recognized that their proportion is decreasing. The decline is all the more marked if we add here again the fact of the large increase in these ages in the general population during the last two decades.

How shall we account for the discrepancy? Is it due to the speeding-up of industry which wears out workers and "scraps" them earlier than formerly? Or is it due to increased average well-being that enables the worker to retire be-

fore having fulfilled the ideal working period of fifty years? Or does indiscriminate charity curtail the worker's self-respect and incidently his working life? Perhaps all of these and other causes conspire to cut the ideal working period from fifty to forty years and even less. Assuming that the average working period should lie between the ages of 15 and 65 (personally I should not make the lower limit in any case below 16), out of every 1,000 males living at age 15 only 444 survive until age 65; 556 fall out as the result of accident and disease. Hence, owing to largely preventable causes, more than half society's working force is dissipated all too early. The mortality rates in certain dangerous trades are indecently high and bear no less upon men under 50 than upon those above. Indeed, in some of these occupations it is comparatively rare to find a man over 50 actively employed. To illustrate: Among Solingen cutlery grinders only 85 out of 1,250 men reached 45; 458 in every 1,000 English steel-grinders die between 35 and 55; only 140 out of every 1,000 grinders attain 55, as compared with 391 in the general population; French slate miners reach an average age of only 48; French mill-stone makers rarely live beyond 45; the same is pretty generally true of housepainters. Among those that survive the mortality rate is still higher, from three to six times higher, than in general industry, agriculture, or the professions. Moreover, many of those who succeed in slipping through the hazards of such occupations are incapacitated after 50 for work in other trades; they drift into hospitals, almshouses, and kindred institutions.

But does general industry, too, use up its workers abnormally? Here the evidence is conflicting. The charge that changes in industry tend to displace the elderly workman is not new. British official studies of unemployment in 1839, 1848, 1850, and 1894 all echoed the same cry that spectacles and grey hair debarred men. The Minority Report of the Poor Law Commission said in 1908, "We suspect, indeed, that the same thing has been alleged ever since the master-craftsman, himself producing and selling his own product, was replaced by the capitalist hirer of labour."

There is good reason, however, for not dismissing the charge

with a wave of the hand. Several English economists and students of social conditions are emphatic in their belief that, as Charles Booth declared, "Modern conditions of industry do not favour the aged. Work is driven faster, and needs more nerve, and its changing methods continually displace the old." Professor Alfred Marshall, Professor J. A. Hobson, Mr. Harold Spender, Mr. Chiozza-Money, and Mr. Percy Alden, to name only a few, are of like opinion. Mr. Chiozza-Money holds that 55 is the "limit of full earning capacity for the average skilled workman. After 55 he is in the greatest danger of dismissal, when work becomes slack. . . . Each grey hair is a deadly enemy to his livelihood." Hobson alleges that progressive underemployment of the middle-aged marks the entire field of industry.

Parallel complaints are heard in our own country. We are assured that scarcely a railroad of any considerable importance will give a worker employment after he has passed 45. Other industries fix the age limited at 40. The meat-packing industry, at least until 1901, by using pace-makers so speeded-up its workers that they were "in a sweat all day, exhausted at night, and useless after forty years of age." An authority on the steel industry, particularly in western Pennsylvania, speaks of the "speeding-up system unparalleled in its effectiveness" of the big, up-to-date rolling mill. He gives no definite figures, but assumes that a twelve-hour day and seven-day week produce old age at 40. President F. A. Vanderlip of the National City Bank of New York told the National Conference of Charities in 1906 that the result of an inquiry among many hundred large American business corporations showed that "most of the employers. . . . regretfully acknowledged that it takes but a few years to use up a man, so high is the pressure at which work is now done." An engineering writer warned his brethren not long ago that it was becoming dangerous to get on the shady side of 40. "Not only is the 'dead line' an established fact in industry; but it is being drawn closer and tighter. A few years ago 45 was considered the limit of the average man's greatest productive efficiency. Forty, and even less, is now regarded as the critical point." It must not be overlooked, however, that

this same writer noted signs of a reaction in the upward direction.

This evidence must be faced with certain contradictions. Rowntree and Lasker, for example, found that in York, England, there was no question of a man's being too old at 40 in the building trades; a man of 60, if a good worker, stood an equal chance with his younger brother. It must be confessed that in other trades they stood less advantageously. The printing trades in England seem fairly favorable to the elderly. Many compositors in newspaper offices still earn fair wages at 65 or even later. The experience of various Friendly Societies shows that a very considerable number of their members over 65 are at work and earning fair wages, especially in rural districts. England's greatest authority on unemployment concludes that the influence of advancing years is not always unfavorable; and that there are some sorts of work at which men continue to gain more skill almost to the end of life itself. This was ably brought out by Booth in his study of London occupations. The lighter, more highly skilled trades, or those that are decayed or decaying, hold excessive proportions of elderly workers. There were also signs that in such trades as silk-weaving, rope-making and clock-making old workmen are retained in spite of the introduction of new machinery. The machinery admits youth-labor; men 25–45 are missing; but the old hands linger on.

In the United States it is by no means the universal practice to discharge aged workmen. It seems even less customary in the East than in the West, probably because of the predominance of skilled trades in the East. Many companies do not discharge skilled employees because of age, but place them on less skilled jobs until pensionable. Indeed, many employers consider men from 45–60 their greatest asset: because they are freer from risk of accident, have learned their trade thoroughly, have matured their judgment, and perhaps we ought to add, have grown conservative and less militant for the "rights of labor." For these reasons they are a more stable labor force, tend to reduce overhead charges, and are less wasteful of materials.

The average superannuation age gives some hint of this

policy. In the general skilled industries it runs from 55 to 65; in the meat industry 55 to 60; in the iron and steel corporations, express and public service corporations, etc., it varies from 55 to 70. The railroads as a rule set 65 for voluntary, and 70 for compulsory retirement; but train and track men may be retired five years sooner. The retiring age for policemen varies from 50 to 65, but depends rather upon length of service or incapacity than upon absolute age. Firemen are pensioned usually at 50 to 55, but here again it is largely a question of length of service. Trade unions in Great Britain that have attempted any old age benefits have pretty uniformly provided that they shall begin at 60 to 65. There is good reason to believe that in some cases at least the superannuation age is rising, despite popular opinion to the contrary. European governmental pension laws allow old age benefits to begin at from 58 to 70 years of age, with a strong tendency to fix 60 to 65 as the normal. Many European cities pension incapacity or compulsory retirement at 60 to 65.

Such age statistics of unemployment as we have, tend to show at least that the common belief in displacement by reason of age remains to be proved. In McLean's study of 720 charity cases where unemployment was alleged as the cause of need, 5 were found to be the result of being crowded out by younger men, 5 the result of old age; 12.6 per cent. of the 496 "genuine" cases of unemployment were over 50 years old. But nearly a third of the total were unskilled workers, with no apparent connection between age and employment. In England practically every reliable recent study of unemployment has shown that unemployment is not so severe among the old. Of all the qualified applicants to Distress Committees in England and Wales, 1907–8, less than 17 per cent. were over 50, while nearly 80 per cent. were between 30 and 50. In York about the same time 88 per cent. of the "regular workers" unemployed on a given day were under 50; 53.2 per cent., under 30. Poor Law returns for the whole of England in 1907 showed that 30.2 per cent. of all applications to Distress Committees were under 30. Hence one may with perfect good grace accept Sir H. L. Smith's dictum that "the chance of unemployment is a function of age"; but with

the reservation that the dangerous age is under 40 rather than, as he thinks, over 50.

Indeed, it is pretty evident that it is not so much the aged as the ill-endowed and ill-educated who in the language of the Poor Law Commission are "very like superannuated fishing boats, drawn up on the shore, and only put in the water at times of exceptional takes." An indirect proof of this comes from the fact that the greatest percentage of workhouse inmates over 10, in the British Census of 1901, were general laborers of various unskilled types. United States Census returns on almshouses are not widely dissimilar. If we compare the occupational groups from which male paupers report themselves as coming, it would appear at first sight that while from 1904 to 1910 the laboring and servant class dropped from 38.8 to 30.9 per cent., the mercantile and trading group increased from 1.9 to 3.2 per cent., and the manufacturing and mechanical industry group rose from 23.6 to 28 per cent. of the total male almshouse population. The clerical, professional, and outdoor labor groups remained stationary. The superficial inference would be that the almshouse is claiming a larger proportion of skilled workers and small traders. But the figures must be taken with reserves. First, because there is no way of checking up whether the men have reported truthfully their past occupations; and second, because the census schedules may so re-classify the various occupations that the resulting groups are not strictly comparable. This would be particularly true of such a heterogenous group as "common laborer"; and it is precisely this group that shows the greatest variation between 1904 and 1910. In any event the unskilled classes still predominate among almshouse paupers. The census gives no correlations between past occupation and present incapacity; all we know in this connection is that about 54 per cent. of all the male almshouse paupers enumerated on January 1, 1910, and about 57 per cent. of all those admitted during 1910 were either able-bodied or able to do light work.

On the whole, then, the chief reason for unemployment among casual laborers is not age, but sickness, inferiority in capacity, push, enterprise, and ability to make a good impres-

sion. The latest study of vocational unpreparedness concludes that "Useless at 25" is the menacing prospect which faces English boys who leave school at 14 to enter blind-alley and unskilled occupations. It is pretty safe to assume that a similar observation holds good for the United States. Hence we must add that unemployment is a function of native endowment, of training, of good temper, and perhaps of other variables besides mere age.

While in general it is true that old age may not cause a worker's discharge, it may prevent his getting a new job if for any reason he loses his place. Sentiment or appreciation on the part of employer as the result of long acquaintance may incline him to retain an aged worker long past the period of his full efficiency; but the same motives do not operate in a strange employer to constrain him to hire an elderly applicant, however worthy. Long continuous employment with one firm is apt to render a man peculiarly helpless when that firm winds up its business or goes bankrupt and discharges him. Such cases are among the most distressing of all the unemployed. Acute discouragement, despondency and an abnormal mortality rate frequently result. The economic principle of mobility of labor constantly breaks down here in practice. Transferability of labor is not very great even for younger men, and is probably still less for the elderly. With the current lack of vocational training and guidance scarcely more could be expected. Mr. H. G. Wells and others have proposed schemes for rotation in employments to secure "inter-occupational mobility," but so far nothing definite has been accomplished. It is certain that in this respect at least the elderly are at a disadvantage.

Trade unions have been charged with injuring the occupational chances of the aged, through strict insistence upon a standard rate of wages regardless of individual capacity. Such a principle would no doubt bear heavily upon the old. But it is not adhered to with rigor. In both England and America many of the unions make express exceptions in favor of members over 55–60, allowing them to work at any rates they can get, or at rates to be approved by their unions. Many unions, too, which have no formal rules on this subject

allow informal exceptions. In general there is no danger to the unions in such practices, provided their standard rate has become firmly established. And there is a positive advantage in that it relieves their superannuation and benefit funds. Still other unions, notably the London Dock Labourers, do not allow elderly members to work at less than the standard wage, but favor them by encouraging the younger men to step aside that the old "may have a turn."

Wide differences of opinion prevail as to the effect of Workmen's Compensation Acts upon early retirement of workers and upon their chances of reëmployment. Judging upon the evidence at present available, I have come to the general conclusion that they have not worked seriously to the older man's disadvantage. Much current opinion to the contrary can be traced to mere excuses given by employers for laying off men, or by loafers among the unemployed for being without a job. It is extremely easy, too, for an inmate of the almshouse or workhouse to charge these laws with his difficulty, when in reality it was largely misconduct or maladaptation. English poor law officials fail to find many cases of men driven to the workhouse on this account. In general the accident insurance companies transacting workmen's compensation business in ordinary industries make no restriction or stipulation in the contract of insurance with regard to old men or men past middle life. The reason is that elderly men have not proved worse risks than the younger. Many studies show that quite the reverse is true, and that the age-group 25–30 rather than 50 is the danger point from the standpoint of employers under these Acts. The same mature judgment that makes the older workman economical of his employer's materials induces caution, and saves him from taking undue risks. It may be that it is too early to judge of the final effects of compensation laws; it may be that they will tend to work cumulative hardship upon the aged, especially those who are more or less physically disabled by reason of defective constitution or accident. But the point remains that those who argue from this assumption either directly against compensation laws in general or indirectly through asking that defectives be allowed to waive compensation provisions

have not yet produced the necessary mass of statistical fact to support their case or to justify a tenable scientific conclusion.*

Finally, the charge is made against scientific management and the efficiency experts that they tend to speed-up workmen, deplete them, and displace them early. It is indubitable that many of the earlier pronouncements of efficiency experts made it seem that scientific management regarded workmen as mere machines to be worked to the limit. They may have disclaimed any such intention, but certainly they failed to remove the adverse impression. Fortunately they have begun to recognize that men are more than mere reservoirs of energy, and that, for the very scientific administration of business itself, workmen must be conserved rather than driven. Mr. Brandeis in his vigorous defense of scientific management denied unconditionally that it either speeds-up or throws men out of employment, or that it even displaces the inefficient. To the contrary, he claims that it helps the inefficient most, because "it supplies instruction, and offers to the teachers special incentives if they succeed in bringing up the hindmost." Now such phrases may be only pretty statements of policy rather than of realized fact; but it is quite apparent that the basic idea involved therein is gaining ground and may be counted on to offset whatever real damage scientific management as an industrial policy may have done to aged workers.

It is a matter of regret that the paucity of statistical data

* It is only fair to state that Miss Coman in a somewhat cursory discussion of the English Insurance Law of 1911 alleged that "bad risks" were being discharged, thus lengthening the period of old age incapacity in England. (See, *Survey*, Feb. 21, 1914, p. 640.) Mr. Francis Feehan of the Pennsylvania Department of Labor and Industry tells me that this is also probably true of America, but that it is not to be considered as serious. The American Federation of Labor at its thirty-fourth annual convention (1914) went into this matter at considerable length. Reports of various delegates showed that, particularly in New York, discrimination on this score was feared by labor leaders. They based their chief arguments against the discriminatory physical examinations upon the fear that men would be rejected as bad risks *not so much because of age as of labor union affiliations*. The discussion centered around Delegate Dujay's Resolution No. 50 which read, in part: "*Whereas*, this scheme of physical examination is detrimental in the extreme to labor, in that it provides a means by which the employers may eliminate from employment all workers whom they might deem it to their interest to eliminate; and, *Whereas*, it is usually to the interest of the employers to remove from their employment the active members of organised labor. . . . *Resolved* that this convention go on record as insisting on our affiliated national and international unions refusing to permit their membership to stand for any kind of physical examination as a consequence of the said compensation law or any other compensation law. . . ." In general it would seem that such discrimination is really a pretext rather than a genuine disability.

precludes a categorical answer to the problem proposed in this paper. But this negative or exceedingly provisional result may stir up somebody to the point of providing more adequate materials. Meanwhile we may conclude that on the whole the elderly worker suffers from lack of vocational training and lack of means for replacement after displacement from an employment long held, rather than from mere age. Old age is frequently only a cloaking phrase for incompetency. In the skilled trades he is better off than in those occupations which simply exploit crude muscular power. The mere introduction of new machinery does not necessarily militate against him, and may actually favor him. Neglect of proper safeguards against accident or disease and in some cases undue speeding-up tend to wear him out too early; but many business men are beginning to realize that this is a suicidal and uneconomical policy. Current social philosophy voices the belief that the ordinary man ought to be preserved for a productive period from the ages of 16 to 65. Pension, superannuation, or retiring allowances tend to fix on 60–65 as the age at which a man should be relieved from full participation in industrial activity. We observe with regret, however, that an undue proportion of men above this age, and even under it, are still dependents or derelicts. Theoretically many people hold that the counsel to give up work at 60 is a medical fallacy, and that any trade which even tends to "scrap" its workers before that age is an economic and social menace; but much remains yet to be done before these principles are fully actualized.

ESTIMATES OF A LIVING WAGE FOR FEMALE WORKERS.

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Nine of the American states have recently passed minimum wage statutes for the benefit of women workers.* In more than that number there are strong and well-organized groups seeking similar legislation. The growing strength and progress of this movement makes the question, What is a living wage for women workers? one of immediate practical importance. In the phraseology of the statutes passed, we have definitions of a minimum wage as viewed by our law-making bodies. The Oregon statute requires wages adequate "to supply the necessary cost of living and maintain health." The California act reads "the cost of proper living." In Wisconsin a living wage means compensation sufficient to enable the employee to maintain herself under conditions consistent with her welfare, and welfare is defined "to mean and include reasonable comfort, reasonable physical well being, decency and moral well being." In general the statutes clearly intend to include more than a bare subsistence wage. They have in view the standard of the Australian arbitration court, "the normal needs of the average employee regarded as a human being living in a civilized community."

Various attempts to give a definite and detailed estimate of the actual cost of living are presented in the following table:

*Since this paper was written the tenth state, Arkansas, has passed a minimum wage law.

	(1) Kentucky.	(2) Baltimore.	(3) St. Louis.		(4) Kansas City.	(5) Minnesota Twin Cities.		Wage Board for Duluth.	(6) Massachusetts.	(7) Boston.	(8) Massachusetts.		(9) Portland, Oregon.
	Week.	Week.	Week.	Year.	Week.	Mercantile.	Manufacturing.		Week.	Year.	Week.	Year.	
Food	$4 00	$3 60[d]	$3 50	$182 00	$3 00	$4 80	$5 00	$4 90	$3 50	$169 70	$4 00	$208 00	$300 00
Rent			2 00	104 00	2 00				2 00	74 81	2 48	128 96	
Clothing	1 40	2 00	1 53	80 00	1 50	2 00	1 92	2 00	1 35	88 99	1 92	100 00	130 00
Laundry	.50	.50	25	13 00	.40	.50	.45	50	.20		55	27 50	25 00
Carfare	.60	.40	60	31 20	60	.40	30	30	60		52	27 04	30 00
Amusement			.20	10 40		.25		25	09		54	28 00	
Vacation			.10	5.00		.10	50	20	19				25 00
Education						.10	10		08	[b]117 06	07	3 05	10 00
Church			.05	2 60			.15	10	10		10	5 20	[c]10 00
Insurance			10	5.20		.06	06	06					
Savings										31 63			
Medical			.20	10 00	[a]1.00	.30	35	38	17	22 00	42	22 09	15 00
Incidentals						04							
Total.	$6 50	$6 70	$8 53	$443 40	$8 50	$8 65	$8 82	$8 60	$8 28	$504 28 $10 00 per week.	$10 60	$550 44	$545 00

(1) Kentucky, Report of Committee to Investigate the Condition of Working Women, 1911, p. 5.
(2) Baltimore, Miss Butler's "Saleswomen in Mercantile Stores," 1912, p. 115.
(3) Estimate of the School of Social Economy of Washington University.
(4) Kansas City Report on Wage-Earning Women 1913, p. 80.
(5) Minnesota First Biennial Report of the Minimum Wage Commission, p. 37.
(6) Massachusetts, Statement and Decree Concerning the Wages of Women in the Brush-making Industry, August, 1914, App. No. 1.
(7) Boston, Miss Bosworth's "Living Wage of Women Workers," 1911, p. 11.
(8) Massachusetts Commission on Minimum Wage Boards, 1912, Appendix D., p. 222.
(9) Oregon. Report of the Social Service Committee of the Consumers' League, 1913, p. 67.
[a] Incidentals, sickness, unemployment. [b] Miscellaneous.
[c] Lodge and church dues. [d] Board and Lodging, $3.00. Luncheon, 60 cents.

Examination of the preceding table shows that estimates of the necessary cost of living for the women workers have varied from a minimum of $6.50 per week, to a maximum of $10.60. The estimates fall into three clearly marked groups: Those of $10.00 or more; those less than $7.00; and those near the estimate of $8.50. The estimates below $7.00 "represent the cost of living at the subsistence level," not a living wage. They include only a minimum provision of food and lodging, clothing, laundry, and carfare. The lowest estimate presented, that of Kentucky, was made by the Commission to Investigate the Conditions of Working Women in Kentucky and represents the cost of living in Louisville. It is obviously not a living wage within the meaning of our statutes. As the Commission stated: "this allows nothing for illness, recreation or ribbons." The estimate for Baltimore is taken from Miss Butler's thoroughgoing and comprehensive study of Saleswomen in Mercantile Stores. It is similar in character to the Louisville estimate in that it presents always the cost "at the minimum" and excludes all items about which debate might arise. It should be noted, however, that it is taken from a study of a single group of wage-earning women and is not a composite estimate including the costs of living of all working women in that city. This fact explains the more generous provision for clothing. It is well-known that the demands made upon the saleswoman, to present a neat and attractive appearance, necessarily result in greater expenditures on her wardrobe. The author * explains that this item "may seem large" and will only be understood if it is remembered that working women are "mediocre human material for the most part, neither very clever, nor very competent, nor very farsighted for the next season's want." "She neither knows how to sew nor wants to spend time sewing. Her leisure is precious, her weariness extreme, and it is easier to buy things." Furthermore, in following this easier way and buying things, she must often, because of the lack of accumulated funds, buy on the installment plan, "an expensive way." It will be noted that a majority of the clothing estimates, presented in the tables, are $2.00 per week.

* Butler, Saleswomen, etc., p. 115 *et seq.*

Just what such a budget signifies will be evident from some further considerations presented by this Baltimore study. The author declares: "That some money should be spent for sundries is no less essential than that some money should be spent for food. . . . But at a weekly cost of $6.70 there could be no doctor's bills, no medicine, there could be no postage stamps, and no carfare, except to and from work; above all, there could be no recreation. Life would be without social content." One must conclude that these exclusions preclude giving such a budget standing as a living wage within the meaning of our statutes. We may agree with the author that were we to maintain it "we would be attacking health and efficiency. The desire for recreation is as fundamental as the necessity for work and the desire for food. A budget which in any measure provides for a sane and useful existence must admit some expenditures other than those essential for the mechanical maintenance of physical life.*

Pass then to a consideration of the estimates at the other extreme, those over $10.00 per week. Miss Bosworth's† study of the Living Wage of Woman Workers is based upon the actual budgets of 450 Boston women. Of these budgets, 399 were complete; 37 of these were furnished by professional workers; 143, clerical; 49 were from saleswomen; 88 from women employed in factories; 64 from waitresses; and 18 from workers in kitchens. Obviously this gives undue weight to clerical workers. These women were grouped into five classes on the basis of wages earned, as follows:

(1) $3.00 to $5.00 per week;
(2) 6.00 to 8.00 per week;
(3) 9.00 to 11.00 per week;
(4) 12.00 to 14.00 per week;
(5) 15.00 and over per week.

* With these estimates of the minumum cost of living should be placed the statement in Miss Butler's Women and the Trades, pp. 346–7. The data were gathered by inquiry among working girls, settlement workers, and club leaders. "They agreed that the minimum below which a working girl can not live decently and be self-supporting in Pittsburgh is $7.00 a week. . . . The weekly outgo for food and lodging would be from $4.50 to $5.00 a week. If $2.00 a week were spent for clothing, there would at most be less than $.50 a week left for washing and ironing; for sundries, which make so formidable an item in the budgets of most of us; for illness, for medicine, for medical care, or for recreation. . . . Yet $2.00 a week is the lowest estimate for clothing made by girls who have themselves grappled with the problem at first hand in Pittsburgh."

† Bosworth, Living Wage, etc., p. 8 *et seq.*

Out of 399 workers:

51 fall in the first group;
185 in the second;
102 in the third;
36 in the fourth;
25 in the fifth.

The expenditures of the individuals in each class have been averaged and the figures presented above are the actual expenditures of the third wage group which were taken as representing the minimum living wage. The basis of the choice is stated: "This class stands midway in the wage scale and represents roughly the average of all women workers covered by the investigation. It appears, moreover, that the average income and the average expenditures of this class approximately balance each other; whereas in the two classes standing lower in the scale there is a deficit of income below expenditure, and in the two classes standing higher in the scale a surplus of income over expenditures according to the tabulated returns. This fact indicates that the income first becomes adequate to meet expenditures when this wage group is reached."

Further indication that the expenditures of this class represent a "fair minimum standard of decency and comfort" is found in the fact that the expenditures for food, rent, and health tend, in general, to rise until the third group is reached and thereafter to remain stationary or to fall. Expenditures for clothing offer a slight exception since the rise in expenditures is continued to the fourth group. Savings also are believed to point to the third group as representing the living wage. In both the lower groups average savings amount to but a few dollars a year. In the third group the average savings of over one hundred wage-earners was $31.63.

Comparison of this estimate of the living wage at $500 per year or $10.00 per week, with the detailed estimates which amount to $8.50 per week will show that the largest divergence is in this item of $31.63 for savings and in the allotment of $107.00 per year to miscellaneous expenditures. As to the first item it is very doubtful whether the statute may be con-

strued to include so large a margin for savings, however desirable it may be intrinsically. The miscellaneous expenditures undoubtedly include a more liberal allowance for amusement, vacation, education, the church, than the investigators of the subject and the wage boards have felt justified in bestowing. On the contrary, the actual medical expenditures were from $5.00 to $10.00 greater than the estimated needs. To be useful as a basis for the determination of living wages under the statutes it would be necessary to exclude from consideration the professional workers since legislation does not ordinarily reach them. The study shows this group to have enjoyed much higher earnings than the remaining occupational groups. Their inclusion, joined to the liberal provision for savings, and miscellaneous expenditures will go far to explain the difference between this estimate and those of the $8.50 per week.

The next estimate No. 8 is taken from Appendix D of the Report of the Massachusetts Commission on Minimum Wage Boards and is the result of two conferences of "some 30 social workers." It is intended to represent "what it would cost a woman of average ability, initiative, and intelligence . . . when living away from home to secure the necessary comforts of life." The item of medical expense is adopted from the study just considered and includes "dentistry, doctor's fees, medicine, and oculist's fees." There would thus appear to be some inaccuracy in the statement that no allowance is made for "unemployment, *sickness*, accident, or old age." Comparison with the various other schedules will show that this estimate is more liberal in practically every item and, aside from the manner of formulating the estimate, the explanation would seem to be that its authors were considering the necessary *comforts*, rather than the necessary *costs* of living.

The last of the estimates of over $10.00 per week is from the report of the Social Survey Committee of the Consumers League of Oregon made as a contribution to the campaign for minimum wage legislation. It is based on over 500 schedules, received from wage-earning women in Portland, supplemented by an investigation of "over 100 rooming-houses, housekeeping rooms and private families offering room and board."

The report concludes: "If we were to omit the sum allowed for recreation, $25.00 per year, we would bring the actual cost to $520 a year, or $10.00 per week for bare necessities." This, it is believed, is the very least on which the average self-supporting woman can keep herself in health and live decently in Portland, and the detailed statement is intended to present the manner in which the money would "be spent were women in all cases living as they should." Of the $300 charged to food and rent $120 is allotted to room rent. By comparison with the estimates whose sum is $8.50 per week, it appears that this higher cost of room joined to the more liberal estimate for the cost of clothing, and the vacation item account for practically all the difference shown.*

The lowest of the estimates in the middle group is that of the Massachusetts Brush Makers Board as reporting to the Minimum Wage Commission. It is noteworthy as an attempt of a board composed of employers, employees, and the public to grapple with the practical problem of the cost of living and reach a working basis for action. The commission had laid down four absolute essentials of decent self-support: (a) respectable lodging; (b) three meals a day; (c) suitable clothing; (d) some provision for recreation, self-improvement and care of the health." Guided by these principles the board "made the same kind of inquiry which any individual seeking food, shelter and lodging is daily making." Their first tentative estimate, as stated in press reports totaled $8.71. This amount was later reduced to $8.28 as presented above. The process of reduction may be indicated by the statement that the laundry item was at first $.50 per week but finally stood at $.20 per week. The board found that lodging "at the lowest

*With this estimate may be compared usefully the detailed statement on pp. 47–65 of the report of the Industrial Welfare Commission of the State of Washington, 1914. The study was based on estimates of 112 wage-earners from four occupations, and estimates of 138 employers and the totals reached were as follows: (See p. 65.)

ESTIMATED TOTAL ANNUAL EXPENDITURES.

By employees	Number.	Amount.
Mercantile	51	$523.27
Factory	15	489.24
Laundry	14	499.27
Miscellaneous (office, telephone, etc.)	32	518.96
	112	
By employers	138	$535.10

level of decency cannot be found in Boston for less than $1.50 per week. A minimum cost for food is at least $3.00 a week. If one has courage to go little beyond keeping warm and dry" clothing cannot be bought "for less than $45 a year, or $.87 per week. For the preservation of health, average expenditures of $8.75 per year, or 17 cents per week seem an irreducible minimum. Carfare requires at least $.60 a week." The budget so built up totals $6.14. To this irreducible minimum the board then added 50 cents per week for food and lodging; 48 cents per week for clothing; and additional items as shown in the table. In conclusion the board reported that $8.28 per week was not "a true living wage" since "it makes no allowance for savings or insurance." Allowing for variation between individuals, the wage board is convinced that the sum required to keep alive and in health, a completely self-supporting woman in Boston is in no case less than $8.00, and in many cases may rise to $9.00 or more." This modest estimate may be compared with the $10.60 reached by the 30 social workers and the $10.00 derived from Miss Bosworth's study.

The studies made in St. Louis and Kansas City, Missouri, are in close agreement in all items except that in St. Louis, 50 cents more is allowed for food, while in Kansas City practically the same sum is included in the more liberal allowance for "incidentals, sickness and unemployment." The St. Louis study was made by Miss Ruth Crawford as a part of a report made to the Senate Commission on Minimum Wage and is based on detailed schedules furnished by 50 working women from occupations fairly representative of the city's female wage-earners, supplemented by a study of the four lodging house districts. The study in Kansas City was made by the Bureau of Labor Statistics in the Board of Public Welfare in that city. It was compiled by an investigator for the bureau after "interviewing about 3,000 working girls." The report concludes; "This estimate is a very conservative one, and, in view of the time frequently lost because of unemployment and sickness, very little would be left for luxuries."

The remaining estimates,* those from Minnesota, are the

*These estimates were furnished through the courtesy of Eliza P. Evans, an efficient member of the Minnesota Minimum Wage Commission.

totals reached after consideration in three wage boards. The items presented in the tables are those adopted by various subcommittees of the wage boards. The Twin City Mercantile Board failed, after two attempts, to get a majority vote on a recommendation for a minimum wage to the Minimum Wage Commission. The Wage considered in these attempts varied from $7.50 to $8.75. The Twin City Manufacturing Board recommended $8.75 a week as a minimum wage for workers of "ordinary ability." The Duluth Board reached substantial agreement at $8.50 per week. This, it will be noted, is somewhat below the total of the estimates of the subcommittees. Such action by substantial majorities of committees composed of persons intimately associated with the industry in question should go far in support of the conclusion that $8.50 per week is the practical basis for action in fixing living wages.* With this conclusion the estimates of St. Louis, Kansas City, and the Massachusetts Wage board closely agree.

Moreover, comparison of the most important items in the table will show substantial agreement in the majority of estimates. Thus, the cost of food, in the majority of cases, falls within the limits of $3.00–$3.50; of rent, within $1.50–$2.00; and of clothing, within $1.50–$2.00. Carfare is usually put at 60 cents; laundry from 25 to 50 cents; medical expenditures from 20 to 40 cents. The largest amount of variation comes in the attempts to estimate such items as amusement, vacation, education, etc. Mention should be made of the failure in all cases, save one, to include any allowance for unemployment. Since studies of wages show that the average wage-earning female loses 10 per cent. of possible working time through loss of days within the week and perhaps as much more through loss of weeks in the year,† a true living wage would necessarily include some provision for this contingency. All in all, the estimates show a substantial advance toward uniformity. This is particularly true if attention is focused on the later estimates and those made as a basis for the fixing of actual minimum wage scales.

*See the writer's paper in the *Quarterly Journal of Economics*, February, 1915.

†*Ibid.*, p. 209, et seq.

Such legal minimum wages have been fixed in five states:* In Utah by statute; in Washington, Oregon, Minnesota, and Massachusetts through the orders of wage boards and commissioners. The Utah scale covers female workers and provides: "for minors under the age of 18, not less than 75 cents a day; for adult learners and apprentices, not less than 90 cents a day; provided that the learning period or apprenticeship shall not extend for more than one year; for adults who are experienced in the work they are employed to perform, not less than $1.25 per day."

The Washington Commission has ordered minimum weekly wage rates for adult females of $10.00 in mercantile establishments; of $9.00 in laundries, dye-works, telegraph and telephone companies; and of $8.90 for factories. For wage-earners under 18 years of age, of both sexes, the minimum weekly wage rate is $6.00. It is provided in the case of mercantile establishments that apprentices shall be paid not less than $6.00 per week during the first six months, and not less than $7.50 per week during the second six months.

The Industrial Welfare Commission of Oregon has ordered that wage rates for experienced adult women in Portland shall be: $9.25 per week in mercantile establishments; $8.64 per week in manufacturing establishments; and $40.00 per month for office workers. The minimum wage rate for such experienced adult workers in all the industries of the state is fixed at $8.25. Inexperienced adult workers may be paid at the rate of $6.00 per week for a maximum period of one year. A minimum rate of $1.00 per day for girls between the ages of 16 and 18 years is established. The rate of $8.64 for women engaged in manufactures has been unanimously sustained by the Supreme Court of Oregon and is at present before the Federal Supreme Court, on appeal from this favorable decision.

The first Minnesota orders were issued in November, 1914. The general minimum for women and minors of ordinary ability was fixed at $8.00, with higher rates as shown below:

*The statement for Utah is quoted from a copy of the law; in Washington, Oregon, and Minnesota the statement is drawn from the printed orders of the Commission; and the Massachusetts order is found in Bulletin No. 3 of the Minimum Wage Commission.

	Cities 1st class	Cities 2nd, 3d, 4th class.	Elsewhere in state.
Mercantile, offices, waitresses, or hair-dressing occupation	$9.00	$8.50	$8.00
Manufacturing, mechanical, telephone, telegraph, laundry, dyeing, dry-cleaning, lunch-room, restaurant or hotel	$8.75	8.25	8.00

It is stated that the orders do not apply to learners and apprentices. The orders are at present suspended, due to an adverse decision in the District Court of the State on the question of their constitutionality.

The only Massachusetts order so far issued applies to the brush-making industry and sets a minimum wage for experienced female employees of 15½ cents an hour. "Assuming an average scale of 50 hours and regular employment, this rate would yield earnings of $7.75" and is thus a conservative ruling. Learners and apprentices are to receive 65 per cent. of this rate as a mimimum and the period of apprenticeship is not to be longer than one year.*

Consideration of the various estimates of the costs of living, and of the various wage orders, due allowance being made for the greater or less expenses connected with various occupations, for the higher costs in the larger cities and the remoter states, and for the varying standards of workers, justifies the conclusion that a working basis for a living wage in the American states is $8.50. As a general statement, $7.00 per week would represent the cost at the subsistence level, an irreducible minimum; and $10.00 the estimated cost where exceptional demands are made on the wage-earner, where expenses are exceptionally high, or where an exceptionally liberal standard is in view.

*A useful summary of these wage orders may be found in the First Biennial Report of the Industrial Welfare Commission of the state of California, pp. 21-22.

THE IMPROVEMENT AND EXTENSION OF THE REGISTRATION AREA.*

By Louis I. Dublin, Ph. D., *Statistician, Metropolitan Life Insurance Company, New York.*

It is my purpose to present the point of view of the public, and especially of the private organizations, in this symposium.

Let me define at the outset what I believe is the attitude of these groups toward this problem. Their chief interest in furthering national vital statistics is to conserve life and health. There are evidences of gross waste in infant life, in early life from preventable infection, and in middle life from the degenerative diseases. There is concern that the new generation is perhaps too largely represented by the offspring of the racial stocks less favored economically, physically, and spiritually. The public has become aware of these conditions not so much through statistical inquiries as through direct observation. Its knowledge is still largely a matter of personal impression. It is now desired to learn the extent of this waste accurately, to locate it definitely, to discover its causes, and to apply suitable remedies. The nation wants the facts. A complete system of vital statistics is the only way to get them.

The contribution of the federal government to this demand for adequate statistical material is a registration area for deaths, covering, up to the present time, about two thirds of the population of the country. A registration area for births exists only as a plan, and an area for reporting disease has not even been seriously contemplated.

The time is opportune for the improvement and extension of the registration service. The public, when properly approached, has responded favorably upon several occasions. In the course of the last two years at least five states—Arkansas, Tennessee, North Carolina, South Carolina, and Georgia—after a campaign of education among the people, have adopted the Model Vital Statistics Law approved by the Bureau of the

*Read at the annual meeting of the American Statistical Association, Princeton, N. J., December 30, 1914.

Census. A number of other states have accepted amendments bringing their statutes into closer agreement with the provisions of the model bill. It is important to note that the social workers and those especially interested in public health are the moving spirits in this educational work. The registration area has been largely extended through the efforts of those fighting for improved infant hygiene, for the control of tuberculosis, and for better working conditions for men and women in industry. The statisticians have played only a subordinate part in these campaigns.

Private organizations are vitally interested in the campaign for better registration. The railways, the telephone and telegraph companies, the large industrial corporations, the life insurance companies—indeed, all public service agencies whose field of operation covers a large part of the country—are concerned with the conditions of life and health of the population. The extension of their markets is often determined by sanitary and hygienic considerations. In addition they are becoming more and more interested in the welfare of their employees. They desire to know the facts of mortality and morbidity as experienced by the men in their plants. Many have accordingly established statistical departments, through which they keep themselves informed as to conditions both within and without their plants. These statistical offices are for the most part ready to further the extension of the registration area.

It will be helpful at this point to refer briefly to what some of the private companies have done to improve vital statistics. Their activities may point out the way in which other organizations can coöperate. The Association of Life Insurance Presidents, for example, has circularized the country in the cause of better registration. It has urged the model bill in many states, has been represented at legislative hearings in behalf of this measure, has held public sessions on the value of statistics, and has given wide publicity to these meetings. A number of individual companies have acted on their own initiative. The agency force of one organization regularly sends to the registrars notices of births occurring among policyholders. This company has distributed to physicians, to legislators, to

women's clubs, and to other groups whose coöperation might be helpful, thousands of pamphlets on the uses of vital statistics. It has advocated the Model Vital Statistics Bill in a number of states, and has asked its agency force and medical examiners to write to their representatives urging this advanced legislation. Still other organizations will be glad to serve in this campaign.

The movement for better vital statistics is suffering, however, from a lack of cohesion among its advocates. What is needed is a central office which will inspire and direct cooperation among the various public and private organizations. This central office should serve as a clearing house for all interested bodies. Its director should be well acquainted with the difficult problems which confront registrars in the states; he should, moreover, inspire confidence among statistical workers throughout the country. If necessary, this central office should be independent of government control, and privately endowed, like so many other philanthropies which have sprung up in recent years to fulfil some noteworthy public function. This is a matter of concern to the members of the American Statistical Association and of other organizations interested in the extension and improvement of the registration service.

Logically, this central office for registration propaganda should be within the Bureau of the Census itself. No other agency occupies so favorable a position both in its organization and in its traditions. The Bureau of the Census has in the past appreciated the importance of this aspect of its work. The former chief statistician of the division of Vital Statistics was a missionary to whose efforts much of the extension of the registration service is due. No one else has mastered the practical difficulties of the problem as he did. His coöperation was always at the disposal of the several states that needed him; his work bore fruit and gave early promise of a nationwide Registration Area. Today the Bureau occupies no such position of vantage in the movement. It is this which gives us such concern, and which, as I understand it, is the chief occasion for this symposium.

If the Bureau of the Census is to maintain its best traditions

as the organizer and as the repository of national vital statistics, it must satisfy a number of exacting conditions.

First: It should be ready to coöperate with state registration officials. Because of the constitutional limitations placed upon the federal service, the Bureau can obtain the fundamental data on mortality only through the courtesy of the states. It would do well, therefore, to endeavor to serve the states in the solution of their registration problems. To this end, the Bureau must have at its disposal a number of active and expert agents whose function shall be to act as consultants to state registrars, especially in the non-registration states. The cordial relations with the states must be maintained as a primary condition of effective service. At the same time there must be a harmonious plan for the transcription and forwarding from the states of the primary documents used by the federal service. The recent administrative ruling of the Director of the Census, reversing the former method of obtaining transcripts, very nearly resulted in the disruption of the Registration Area.

Second: The Bureau of the Census must be entirely nonpartisan. Changes in national administration should not, as a matter of course, involve changes in directors, with the inevitable upheaval in policy and practice which these occasion in the Bureau. The work of this office is essentially scientific and technical in character. Experience should count as a chief consideration. The displacement of tried and efficient chiefs of division is, therefore, subversive of Bureau efficiency. Nor should political considerations be allowed to interfere with the accuracy of Census returns. Demands for padded population counts and for the publication of mortality rates in such a form as would make sanitary conditions appear better than they really are should receive no encouragement whatever from the Census Bureau. This office must always stand out as the exponent of truth, whatever the cost may be.

Third: The Bureau of the Census should encourage and guide public and private organizations in their statistical work. Industrial establishments and philanthropic institutions of all sorts are collecting vital statistics, the tabulation and the publication of which would prove of much greater value if they

were carried on in accordance with the standard practice of the Bureau. A well-directed effort toward this end would probably result in standardizing the compilations of the hospitals and sanatoria, the visiting nurse associations, and especially the life insurance companies. These last institutions—particularly the large industrial companies—possess a wealth of most useful data on mortality, which could readily be made to supplement the reports of the Bureau of the Census. Indeed, the record of their mortality experience in the non-registration states would prove to be the very best available measure of the sanitary conditions of these sections.

Fourth: The Bureau of the Census should become more active as an educational agency in the dissemination of statistical knowledge. Much of the material prepared by the Bureau, if properly analyzed and edited for the press, would prove of the greatest public interest. Such contributions would be especially helpful in furthering the movements for better hygiene and sanitation throughout the country. They would also result in increasing the amount of statistical instruction in our schools and colleges. This policy would leave a very definite impression upon the mental attitude of the people toward statistics, and the demand for better and wider registration would not be so easily denied or ignored by our States. In this way the foundation would be laid for nation-wide vital statistics.

In conclusion, let me say that the chief requirement at this time for the improvement and extension of our registration service is a better appreciation, by those who are directing the statistical work of the states and of the federal government, of the fact that they have in their hands the key to the solution of some of our most vexing problems.

OSCULATORY INTERPOLATION FORMULAS.

By C. H. Forsyth, *Ann Arbor, Mich.*

The best formulas of interpolation, making use of finite differences, are Newton's, Everett's, Stirling's, and Bessel's which are as follows:

Newton's formula:

$$u_x = u_0 + x\Delta u_0 + \frac{x(x-1)}{2!}\Delta^2 u_0 + \frac{x(x-1)(x-2)}{3!}\Delta^3 u_0 + \cdots.$$

Everett's formula:

$$u_x = f(\xi)u_0 + f(x)u_1$$

where $f(x) = x + \dfrac{(x+1)^{(3)}}{3!}\delta^2 + \dfrac{(x+2)^{(5)}}{5!}\delta^4$

$$= \left(x + \frac{(x+1)x(x-1)}{3!}\delta^2 + \frac{(x+2)(x+1)x(x-1)(x-2)}{5!}\delta^4\right)$$

and ξ is the distance of u_x measured behind u_1.

Stirling's formula:

$$u_x = u_0 + n\bar{\delta}u_0 + \frac{n^2}{2!}\delta^2 u_0 + \frac{n(n^2-1)}{3!}\bar{\delta}^3 u_0 + \frac{n^2(n^2-1)}{4!}\delta^4 u_0$$
$$+ \frac{n(n^2-1)(n^2-4)}{5!}\bar{\delta}^5 u_0 + \cdots.$$

Bessel's formula:

$$u_x = u_0 + n\delta u_{\frac{1}{2}} + \frac{n(n-1)}{2!}\bar{\delta}^2 u_{\frac{1}{2}} + \frac{n(n-1)(n-\frac{1}{2})}{3!}\delta^3 u_{\frac{1}{2}}$$
$$+ \frac{n(n^2-1)(n-2)}{4!}\bar{\delta}^4 u_{\frac{1}{2}} + \frac{n(n^2-1)(n-2)(n-\frac{1}{2})}{5!}\delta^5 u_{\frac{1}{2}} + \cdots.$$

Thus Newton's formula is based upon ordinary differences and the three others upon central differences whose notation is explained by the following table:

$$
\begin{array}{cccccc}
u_{-2} & & & & & \\
 & \delta u_{-\frac{3}{2}} & & & & \\
u_{-1} & & \delta^2 u_{-1} & & & \\
 & \delta u_{-\frac{1}{2}} & & \delta^3 u_{-\frac{1}{2}} & & \\
u_0 & & \delta^2 u_0 & & \delta^4 u_0 & \\
 & \delta u_{\frac{1}{2}} & & \delta^3 u_{\frac{1}{2}} & & \delta^5 u_{\frac{1}{2}} \\
u_1 & & \delta^2 u_1 & & \delta^4 u_1 & \\
 & \delta u_{\frac{3}{2}} & & \delta^3 u_{\frac{3}{2}} & & \\
u_2 & & \delta^2 u_2 & & & \\
 & \delta u_{\frac{5}{2}} & & & & \\
u_3 & & & & &
\end{array}
$$

We shall use the central difference symbols but with a dash over them to designate the arithmetic averages of the differences of the same order on both sides of them. Thus $\bar{\delta} u_0 = \frac{1}{2}(\delta u_{\frac{1}{2}} + \delta u_{-\frac{1}{2}})$, and so on for the rest. We believe that this latter idea is an improvement over that of Mr. Sheppard,* who contrived the scheme of representing central differences shown in the above table, in which a separate character μ is introduced instead of the dash which we suggest. We consider the use of the character μ in such a way to be very misleading.

The purpose of this paper is threefold. First we wish to give the results of our derivations of the osculatory formulas based upon Stirling's and Bessel's formulas corresponding to those which have been derived based upon Newton's† and Everett's‡ formulas, all to be used for interpolating four values between two of a series of equidistant values by fifth differences. Second, we wish to bring together all four osculatory formulas for purposes of comparison and future reference. Third, we wish to offer for future reference formulas for computing fifth leading differences to be used in connection with the applications of the four osculatory interpolation formulas, to simplify the computation when several successive intervals are to be considered.

As is well known, all interpolations within a series of successive intervals are performed through the use of a series of

*Proceedings of the London Mathematical Society, Vol. XXXI, p. 449.
† Journal of the Institute of Actuaries, Vol. 22., p. 270.
‡ J. I. A., Vol. 42, p. 369.

what might be called partial interpolation curves. In osculatory interpolation, the "joints" of these separate interpolation curves are welded together in a more satisfactory manner by requiring that not only the slopes but also the curvatures of any two interpolation curves to be the same at their point or points of intersection. Thus the two interpolation curves, one through the points u_{-2}, u_{-1}, u_0, u_1, and u_2, the other through u_{-1}, u_0, u_1, u_2, and u_3 are required to have equal slopes and equal curvatures at the two points u_0 and u_1 for purposes of interpolating any number of values (four, in this paper) between u_0 and u_1. This modification tends to remove the discontinuities usually found at the intersections of two distinct interpolation curves.

This method of interpolation has been termed "osculatory" interpolation because the successive pairs of partial interpolation curves are thus seen to have a common osculating circle at their points of intersection. It was first devised by Sprague* and later developed and applied by Karup,† King,‡ Buchanan,§ and others.‖ The method or rather modification has already been applied to Newton's* and Everett's§ formulas, the latter of which involves only even central differences of each of the middle pairs of the series of values between which the interpolations are to be made. The central difference formulas, Stirling's¶ and Bessel's, are so widely used that it seemed well worth while to obtain the osculatory formulas for them as well as for Newton's and Everett's formulas.

The process of deriving the osculatory formulas wherein analytically first derivatives are considered in lieu of slopes and second derivatives in lieu of curvatures has been explained so well in connection with the derivation of Sprague's formula (based upon Newton's formula) and Buchanan's formula (based upon Everett's formula), and especially in an independent note by Lidstone**, that we shall give simply the final

* Journal of the Institute of Actuaries, Vol. 22, p. 270.
† Trans. Second International Actuarial Congress, p. 78.
‡ J. I. A., Vol. 42, p. 225.
§ J. I. A., Vol. 42, p. 369.
‖ Quarterly Pub. Amer. Stat. Assoc., June, 1910.
The Record. Amer. Inst. of Actuaries, June, 1911.
¶ Text-book. Institute of Actuaries, p. 447.
** J. Inst. Act., Vol. 42, p. 394.

equations of the two curves. The one based upon Stirling's formula becomes

$$u_x = u_0 + x\bar{\delta} u_0 + \frac{x^2}{2}\delta^2 u_0 + \frac{(x^3 - x)}{3!}\bar{\delta}^3 u_0 + \frac{(x^4 - x^2)}{4!}\delta^4 u_0 + \left(\frac{x^5}{20} - \frac{x^3}{4} + \frac{x}{5}\right)\frac{\bar{\delta}^5 u_0}{3!} \qquad (1)$$

The equation based upon Bessel's formula becomes

$$u_x = u_0 + x\delta u_{\frac{1}{2}} + \frac{(x^2 - x)}{2}\bar{\delta}^2 u_{\frac{1}{2}} + \left(x^3 - \tfrac{3}{2}x^2 + \frac{x}{2}\right)\frac{\delta^3 u_{\frac{1}{2}}}{3!} + \frac{(x^4 - 2x^3 - x^2 + 2x)}{4!}\bar{\delta}^4 u_{\frac{1}{2}} + \frac{(-x^5 + 2x^4 - x^3)}{4!}\delta^5 u_{\frac{1}{2}} \qquad (2)$$

If we substitute successively $x = \frac{0}{5}, \frac{1}{5}, \cdots, \frac{5}{5}$ in equations (1) and (2), and difference each of the sets of six results five times we obtain the two desired sets of leading differences for interpolating four values between u_0 and u_1.

The osculatory leading differences based upon Stirling's formula are:

(1)	$\frac{\bar{\delta} u_0}{5}$	$+\frac{1}{2}\,\frac{\delta^2 u_0}{5^2}$	$-4\,\frac{\bar{\delta}^3 u_0}{5^3}$	$-\,\frac{\delta^4 u_0}{5^4}$	$+\,\frac{\bar{\delta}^5 u_0}{5^4}$	
(2)		1 "	+1 "	$-\frac{3}{2}$ "	+3 "	
(3)			1 "	$+\frac{3}{2}$ "	−3 "	(A)
(4)				1 "	−2 "	
(5)					5 "	

The osculatory leading differences based upon Bessel's formula are:

(1)	$\frac{\delta u_{\frac{1}{2}}}{5}$	$-2\,\frac{\bar{\delta}^2 u_{\frac{1}{2}}}{5^2}$	$+\,\frac{\delta^3 u_{\frac{1}{2}}}{5^3}$	$+\,\frac{9\bar{\delta}^4 u_{\frac{1}{2}}}{5^4}$	$-\frac{2}{15}\,\frac{\delta^5 u_{\frac{1}{2}}}{5^4}$	
(2)		1 "	$-\frac{3}{2}$ "	−4 "	$-\frac{1}{3}$ "	
(3)			1 "	−1 "	$+\frac{1}{3}$ "	(B)
(4)				1 "	+ 0 "	
(5)					− 1 "	

The osculatory leading differences derived by Buchanan, based upon Everett's formula are:

$$
\begin{array}{llllllll}
(1) & -\frac{u_0}{5} & -6\,\frac{\delta^2 u_0}{5^3} & +8\,\frac{\delta^4 u_0}{5^4} & +\frac{u_1}{5} & -4\,\frac{\delta^2 u_1}{5^3} & +\,\frac{\delta^4 u_1}{5^4} & \\
(2) & & 4\ \text{''} & -7\ \text{''} & & +1\ \text{''} & +3\ \text{''} & \\
(3) & & -1\ \text{''} & +2\ \text{''} & & +1\ \text{''} & -3\ \text{''} & \qquad (C) \\
(4) & & & 3\ \text{''} & & & -2\ \text{''} & \\
(5) & & & -5\ \text{''} & & & +5\ \text{''} &
\end{array}
$$

The osculatory leading differences derived by Sprague, based upon Newton's formula are:

$$
\begin{array}{lllllll}
(1) & \frac{\Delta u_0}{5} & +8\,\frac{\Delta^2 u_0}{5^2} & +11\,\frac{\Delta^3 u_0}{5^3} & -11\,\frac{\Delta^4 u_0}{5^4} & +\,\frac{\Delta^5 u_0}{5^4} & \\
(2) & & 1\ \text{''} & +6\ \text{''} & +1\ \text{''} & +3\ \text{''} & \\
(3) & & & 1\ \text{''} & +4\ \text{''} & -3\ \text{''} & \qquad (D) \\
(4) & & & & 1\ \text{''} & -2\ \text{''} & \\
(5) & & & & & 5\ \text{''} &
\end{array}
$$

To apply these different sets of leading differences, the observed series of values are differenced as usual, the differences averaged wherever necessary in connection with the central differences and finally each difference divided by the appropriate power of 5 (or multiplied by the corresponding decimal). The leading differences themselves are then formed according to the above tables. Each group of six original values will have its own set of differences for interpolating four values between the inmost pair, but if a series of successive intervals are to be interpolated the best plan is to interpolate the first interval as outlined above and then compute merely the appropriate fifth leading differences for the succeeding intervals such that by continued summation or addition to the preceding leading differences of lower order (in each case) the required interpolations will be obtained. The possibility of this plan has been pointed out before* and we shall merely carry it out as Buchanan has done in connection with his treatment of Everett's formula. Not being able to find the formula for computing these fifth differences in connection with Sprague's formula, we have derived these formulas for this case as well as for the osculatory formulas based upon

*J. I. A. Vol. 42, p. 285.

Stirling's and Bessel's and derived in this paper. The method of derivation is outlined by Buchanan in his paper. These formulas or corrections of fifth differences for all four osculatory formulas are as follows:

	Newton's		Everett's		Stirling's		Bessel's	
	$\frac{\Delta^5 u_0}{5^4}$	$\frac{\Delta^6 u_0}{5^4}$	$\frac{\delta^5 u_{\frac{1}{2}}}{5^4}$	$\frac{\delta^5 u_{\frac{3}{2}}}{5^4}$	$\frac{\delta^5 u_{\frac{1}{2}}}{5^4}$	$\frac{\delta^5 u_1}{5^4}$	$\frac{\delta^5 u_{\frac{1}{2}}}{5^4}$	$\frac{\delta^6 u_1}{5^4}$
(1)	+4	1	3	1	3	1	$-\frac{1}{3}$	$4\frac{11}{36}$
(2)	−6		−6		−6		3	−15[illegible]
(3)	−6	−6		−6		−6	$\frac{1}{3}$	17[illegible]
(4)	4	3	1	3	1	3	$-1\frac{1}{6}$	$-6\frac{1}{4}$
(5)	5	5		5		5	−1	−1

The greatest disadvantage found in connection with the use of the above fifth differences is that usually the work should be carried to a greater number of decimals than if the above leading differences were used. If an appropriate computing machine is available this criticism is of no importance. As a general rule the work in connection with the leading differences should be carried to two more decimals than are to be finally retained and the work of the fifth differences to three or the maximum four.

One great advantage in the use of the above osculatory formulas is the accompanying check upon the computation, for the sets of leading differences not only lead to interpolations of the four values between a pair of intermediate original values but will also reproduce these original values and since the process of continued summation causes any errors in the computation to accumulate, such errors are readily caught.

Without going into the details, it should perhaps be pointed out that Bessel's and Everett's and hence the corresponding osculatory formulas lead to about the same degree of accuracy but are generally considered to be the most accurate of the four formulas considered in this paper. However, Everett's formula and the corresponding osculatory formula involve considerably less as well as simpler computation than Bessel's formula and its corresponding osculatory formula. The osculatory formula based upon Stirling's formula is very little less ac-

curate than those based upon Everett's and Bessel's formulas and is remarkably easy to apply although scarcely as easy as Buchanan's (that based upon Everett's). There is scarcely any justification in the further use of Sprague's osculatory formula since the derivation of the formulas for the other osculatory interpolations, leading as it does to results nowise as accurate and involving much computation.

In conclusion the following example is given to show the use of the above sets of leading differences. The following values of u are arbitrarily chosen and the corresponding differences found in the usual way as shown.

$u_{-2}=4673423$					
	13462				
$u_{-1}=4686885$		6321			
	19783		384		
$u_0=4706668$		6705		65	
	26488		449		13
$u_1=4733156$		7154		78	
	33642		527		
$u_2=4766798$		7681			
	41323				
$u_3=4809121$					

Here we have, for example, $\bar{\delta}u_0=\frac{1}{2}(19783+26488)$

The results after applying the four sets of leading differences are:

By (A)	By (B)	By (C)	By (D)	(C)-(A)	(C)-(B)	(C)-(D)
$u_0=4706668$	4706668	4706668	4706668	0	0	0
4711406	4711397	4711397	4711416	9	0	19
4716418	4716401	4716401	4716435	17	0	34
4721710	4721691	4721691	4721729	19	0	38
4727287	4727273	4727273	4727301	14	0	28
$u_1=4733156$	4733156	4733156	4733156	0	0	0

REVIEWS AND NOTES.

NOTE ON A CERTAIN USE OF FINANCIAL STATISTICS.

In the QUARTERLY PUBLICATIONS for September, 1914, p. 236, Professor Nearing has an interesting article, entitled "Service Income and Property Income," which makes use of various statistical reports, especially those of railroad and other public-service commissions. In addition to being interested in the subject, my attention was naturally attracted to the use made of data from reports of the New York Public Service Commission for the First District, with which my position makes me familiar. The following remarks relate primarily to this point.

On page 248 "a total compensation of $28,632,580, and a total payment of interest and dividends of $12,204,640" for the street railways of the district in question, which is substantially New York City, are cited for 1911, the reference being to Vol. II, p. 133 and p. 327 (instead of, as incorrectly printed, to pp. 133–326). Text Table 37, which is on page 133, consists of the totals for two years of the general table showing income (and surplus) statements for street railways. This is Table XVI, A, and in the 1911 volume is at page 390. The other reference is direct to general Table XII, C.

Rounded to thousands of dollars, income deductions and dividends of the operating street railways of New York City for 1911 were as follows:

	Thousands of dollars.
Interest on funded debt	7,828
Other interest	2,579
Rent of road and equipment	12,242
Other rent	1,127
Other deductions	416
Total deductions from gross income	$24,192
Net corporate income	$10,171
Dividends	$4,376

Professor Nearing's "property income" is the sum of the first and last items. But, on the face of the data, why is not substantially all the $24,192,000 of income deductions, as well as the dividends, counted as "property income"? The small qualification theoretically necessary on account of the inclusion of non-operating income and income from outside operations should have the same sort of effect upon dividends as upon net income. In fact the essential distinction between revenue deductions and income deductions is that the latter are payments for the use of property, while operating expenses consist of costs for materials and services currently consumed and of charges for maintenance of the fixed investment. It is

true that what is cost to the company is not necessarily return to the investor. As appears from the footnotes to the items in Table XVI, A, "Other deductions" consist almost entirely of sinking-fund payments and amortization of debt discount and expense. We may therefore throw out this item. Rents, however, are payments for the use of property. Doubtless a considerable maintenance element is included in "Other rent charges." But "Rent of road and equipment" is, as Professor Nearing could easily have ascertained, composed almost entirely of dividends and interest upon outstanding securities of lessor street-railway companies. In division B of Table XVI, at page 394, these details are set forth. The lessors of the Interborough Rapid Transit show $3,399,000 interest on funded debt and $4,200,000 dividends, $7,599,000 being thus accounted for out of the $8,106,000 paid by the Interborough. Lessees of the various B. R. T. companies show $454,000 interest on funded debt and $971,000 dividends, or $1,425,000, out of $2,313,000 to be accounted for. Interest on funded debt shown by lessees of the predecessor of the New York Railways was $554,000 and dividends $1,410,000, or $1,964,000 in all, that is, more than sufficient to account for the $1,810,000 distributed by the company in question, the difference being explicable by the different bases of credit and debit accruals as between lessors and the bankrupt lessee. Thus, Professor Nearing's property-income item should be increased by $10,988,000, or nearly doubled.

In view of the well-known tendency on the part of railroads to obtain capital through note issues, some of the "Other interest" items are also certainly worthy of examination. The facts may be ascertained by reference to the abstracts of the companies' individual returns contained in Part III of the volume in question.* Substantially all the $1,596,000 thus charged by Brooklyn Rapid Transit companies is interest paid to the holding company which finances the requirements of its controlled street railways by means of demand notes. These are pledged as security for the mortgage indebtedness of the holding company. Altogether Professor Nearing's error of method is by no means insignificant in its effect on his statistics. His property income figure should be at least doubled.

The $28,633,000 for wages and salaries is not open to similar criticism. In this case lessor companies do not complicate matters. However, the amount includes wages charged to fixed capital and to that extent is not a regular annual charge. For this reason the ratio of "service income" to "property income" might better be determined by the study of a series of years.

The same remark applies to dividends. Even funded-debt interest was in an abnormal condition in New York City in 1911, when all the great surface roads of Manhattan and The Bronx were in the hands of receivers. This group of surface roads paid $1,080,393 in funded-debt interest in 1911, before the reorganization of the Metropolitan and Third Avenue railways, and $4,484,008 in 1913, after the reorganization. None of these companies paid dividends in either year.

*Pages 471, 482, 490, 523, 614, 675, and 690.

Professor Nearing also cites (on p. 249) data from vol. III of the 1911 Annual Report of the Public Service Commission for the First District. His reference is merely, in too large a way, to the volume as a whole. The two classes of income in question are stated for "gas companies," for the "electric companies," then for "companies operating both gas and electric franchises." For the last described group the figures given are: Total compensation, $16,850,676; total of interest and dividends, $19,443,164. These totals are somewhat larger than the sums of the figures previously cited. The difference may be accounted for by the three small gas-electrical companies. Reference to Table XXXVII at page 328 serves to verify the (funded-debt) interest and dividends, as stated for gas companies and for electrical companies separately. The combined figure, however, is peculiar in a way that will be explained shortly. The sub-group figures for compensation are similarly verifiable by reference to Table XXXI at page 262, except that the Flatbush Gas figure has not been deducted to obtain the "gas companies" figure and has been deducted to obtain the "electric companies" figure. Apparently the name of this company was allowed to mislead the compiler as to the fact of its being a gas-electrical company, though the evidence that it is such should have reached his consciousness through his use of data close at hand. The figure of total compensation is identifiable except for what is evidently an error of $1,000,000 in addition, transcription, or typography; that is, the total compensation to employees in the district, paid by gas, electrical, and gas-electrical companies appears in Table XXXI as $15,850,676. In addition to this, however, the Consolidated Telegraph and Electrical Subway, a conduit company, paid out $946,206 in compensation; and the Empire City Subway Company, $327,658.* The $1,000,000 mentioned above might have been intended to allow for wages paid by these conduit companies, most, but not all, of whose property is used by the electrical companies. But in that case one would expect the final figure also to be rounded, and verification of the process of obtaining it should have been facilitated by adequate references.

The $19,443,164 cited by Professor Nearing as interest and dividends appears to have been obtained by adding to the figures for gas companies and for electrical companies combined, the similar figures for gas-electrical companies, that is, funded-debt interest and dividends, and then—instead of stopping at this point as all his other corresponding figures do—further adding "Other interest," not merely for operating lighting companies, but the gross total of Table XXXVII, inclusive of electrical subway and non-operating companies. This procedure is unexplained and is, indeed, hardly explicable. Because of the interest of the question as to what kind of figures should have been taken for the purpose in hand, the figures of Table XXXVII are presented below on three possible bases (all amounts being in thousands of dollars):

* Cf. pp. 421 and 435 of the Report, Vol. III.

	Operating, Except Conduit, Companies	All Operating Companies	All Companies, Operating and Non-operating
Interest on funded debt......	$4,851	$5,461	$5,690
Other interest...............	2,642	3,309	3,325
Rent for lease of gas or electric plant....................	1,632	1,632	1,632
Other rent..................	1,623	1,623	1,623
Other contractual deductions..	12	12	12
Amortization of debt discount and expense.............	55	55	58
Total deductions..........	$10,815	$12,092	$12,340
Net corporate income........	$22,715	$23,131	$24,113
Dividends................	$11,267	$11,542	$12,342

It is impossible to obtain $19,443,000 by any combination of interest and dividends here shown, either according to the method of Professor Nearing's street-railway total or otherwise. It is also of fundamental importance that the figures above tabulated are for a group of companies largely associated with one another, with resulting inter-company payments of dividends, etc. In particular, the Consolidated Gas Company, in addition to being an operating company, is well known to be one of the most important holding companies in the country. The electrical subway or conduit companies have been already mentioned as deriving their income almost entirely from the revenues of the electrical companies. This is only more completely true of the non-operating companies. Hence the first column of figures in the above summary is, of the three, least subject to qualification on this account. The total of interest (on funded debt) and dividends obtained from it is $16,118,000.

But the Consolidated Gas Company had $5,731,000 of "Other income," not derived from gas operations, from which to pay dividends, and the New York Edison Company had similar income of $1,081,000. Consolidated system (incl. N. Y. Edison Co.) duplications are not to any appreciable extent due to leases of gas or electrical plants, hence the duplication cannot be eliminated by dealing with operating companies only and including as return on property rent paid to lessors, as is possible in the case of the street railways. But in fact the $1,632,000, "Rent for lease of gas or electric plant," in question is properly to be added to the operating-company interest and dividends because chiefly payable by the Edison Electric Illuminating (Brooklyn) to its lessor, as is explained in a footnote. This raises the $16,118,000 to $17,750,000, but without the Consolidated system duplications having been attended to. Because of this element in the situation it is impossible to get a satisfactory figure of the character sought without a detailed analysis of the income accounts of the various asso-

ciated companies. This is too large a task to undertake casually, and the data printed in the report are probably not sufficient to permit of its complete accomplishment. But it happens that something of the sort was attempted with the previous year's figures and the results appear in the 1910 Report, vol. IV, p. 97 ff. The Comparative Summary of Financial Data for 1910, unlike its successors, carries the process of deduction for duplications through the entire income and surplus accounts. Significant data therefrom are as follows:*

		1909.	1910.
Interest payable accrued on funded debt	Gross,	$6,738,675	$6,723,034
	Net,	5,650,625	5,572,806
Dividends paid	Gross,	9,480,231	10,663,751
	Net,	6,418,833	7,293,527
Combined	Gross,	16,218,906	17,386,785
	Net,	12,069,458	12,866,333

In these figures both subway and non-operating companies are included. The ratios of net to gross are as follows: 1909, funded-debt interest 83.85 per cent. and dividends 67.71 per cent.; 1910, funded-debt interest 82.89 per cent. and dividends 68.40 per cent. These per cents are nearly enough constant so that we may estimate the net figures for 1911 as 68 per cent. of gross dividends and 83 per cent. of gross funded-debt interest. This gives $8,393,000 dividends and $4,723,000 interest. To these should be added "Rent for lease of gas or electrical plant," $1,632,000, about half of the "Other interest," or another $1,600,000 and, finally, most of the "Other rent," paid to the subway companies, amounting to about $1,500,000. Altogether these amount to $17,850,000. That Professor Nearing's figure is only about $1,600,000 away from this figure is a mere accident.

Professor Nearing has touched a subject of great practical importance as well as of great statistical interest and difficulty. In order to do justice to both these viewpoints, however, it would seem to be necessary to treat the subject in a much broader way than he does. Broadly conceived, the problem is to determine what are the typical operating and financial ratios for each of the various branches of business. This is a matter of financial or accounting statistics. Data are as yet rather limited, though the exercise of the powers of the new federal trade commission should in time fill many of the gaps. But it is with Professor Nearing's procedure, not with his data, that fault must be found. The mere extraction from statistical reports of figures showing dividends and funded-debt interest paid in a particular year will not give a correct idea of return to property. A broader view of the disposition of revenues as a whole is necessary as a check upon, or qualification of, figures so obtained. In the volume of street-railway statistics cited by him, that is, in Table XV, F, for 1911,† Professor Nearing will find certain ratios presented, which show, among

* Page 100 of Vol. IV of the Commission's Annual Report for 1910.

† Page 388. Similar distributive ratios for gas and electricity can be found in the Vol. III. above referred to.

other things, that the operating street railways in that year paid (or accrued) for interest deductions an amount equal to 12.43 per cent. of their revenues; for rent deductions, 15.96 per cent.; and carried to the surplus account 12.14 per cent. Taxes accounted for 6.56 per cent. and operating expenses, for 54.92 per cent. of revenues. Other deductions took 0.50 per cent. The total of these items adds to more than 100 per cent. because the companies derived a net amount from other than street-railway operations equal to 2.51 per cent. of operating revenues. The extent to which compensation to officers and employees accounts for the 55 per cent. operating ratio is not shown in this table, because the classification of operating expenses does not keep such charges separate, though such procedure would certainly be highly desirable from a statistical viewpoint. The ratios stop with the surplus for the year, as does the income account. Theoretically this is practically all available for dividends. An intensive study of Professor Nearing's problem would have to consider just how far this view needs to be qualified in the long run. If a surplus is accumulated from undivided profits, is the property income less merely because profits are saved and reinvested by the corporation instead of being paid out to the stockholder, perhaps by him to be saved and reinvested? There is also the question as to whether depreciation has been adequately provided for before the figure of net income for the year is obtained. Still there remains the pervasive and evasive matter of intercorporate relations and their effects upon totals.

A statistical study of the sort Professor Nearing has undertaken requires careful attention to the economic and accounting relations that underlie the figures used. It is for lack of care in these respects, even more than for his too hasty use of sources that he is to be criticized.

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WHY DISTRIBUTIVE PERCENTAGES AS PUBLISHED IN THE REPORTS OF THE BUREAU OF THE CENSUS DO NOT INVARIABLY ADD TO 100.

In an article contributed to the December issue of the Quarterly Publications, the Bureau of the Census is stigmatized as guilty of "careessness" or "slovenliness" because of the fact that in the reports of that Bureau, distributive or constituent percentages do not always add to 100.0. The Bureau was well aware of this fact. It results from a deliberate policy which it seems necessary to explain now that it has been made the subject of public criticism, even though the explanation is a matter of very elementary mathematics. Persons interested in the question may then judge for themselves whether the practice of the Bureau is right or wrong.

In Census work, percentages are expressed with decimal remainders carried out to one place. Thus the percentage which 125 is of 1000 would

be expressed as 12.5. Usually, however, percentages so expressed are not, as in this instance, exact. They are approximations and being approximations they will not invariably add to 100.0 unless they are adjusted so as to make them add to that. A simple illustration will show this. Take the following in which each item is exactly one-third of the total:

Items.	Amounts.	Per Cent. of Total.
A.........	422	33.3
B.........	422	33.3
C.........	422	33.3
Total........	1,266	100.0

Here the percentages add to 99.9, yet each percentage is as nearly exact as it can be when carried out to only one decimal place. If, in order to make these percentages add to 100.0, one of these percentages is changed to 33.4 it becomes less exact than it was before, the exact percentage in each instance being nearer 33.3 than 33.4.

Although the constituent percentages in the above example add to 99.9 the percentage for the total is nevertheless given as 100.0 mainly for the reason that 100.0 is the true percentage and absolutely exact. It is just what it purports to be, viz., the percentage which the total is of the total. Furthermore, expressed as 100.0, it has the practical advantage of indicating to the reader that the percentages given above are the percentages which the items form of the total, 1266.

In view of this fact that percentages which have been adjusted so as to add to 100.0 are less exact than they were before the adjustment was made the Bureau of the Census some years ago deliberately abandoned the practice of adjusting percentages. Incidentally, however, the change was in the interests of economy as well as accuracy, for when, as is so often the case in census work, a large number of items are given, the adjustment, which must be made according to prescribed rules, involves considerable clerical labor.

JOSEPH A. HILL.

MECHANICAL DEVICES IN EUROPEAN STATISTICAL WORK.

To those familiar with the development of statistical methods it is well known that the introduction of mechanical devices for performing the clerical work has been one of the important factors in extending the range and improving the quality of the results in recent years. Not only is accuracy improved, due to the fact that machines do not make mistakes, a point in which they differ in an astonishing degree from the human organism, but of equal or greater importance is the extension in the quantity and complexity of statistical work which the mechanical methods

make possible, the mere labor of which would have been out of the question under hand tabulation and computation. In view of the lead taken by the United States in this branch of work, which may be called an American contribution, and of the fact that so many of the devices have been the product of "Yankee ingenuity," some data on the increasing use of such appliances in Europe may be of interest. Two circular inquiries sent out by the *Deutsches Statistisches Zentralblatt* * of Berlin to the various statistical bureaus and offices of Europe, one at the beginning of 1910 and the other at the beginning of 1914, have brought together some fairly complete figures. The following table, collated and condensed from this journal, shows the progress in the four years, amounting to nearly a doubling of the number of machines of all types in use.

NUMBER OF MACHINES BY CLASSES IN EACH COUNTRY.

Country.	Tabulating and Counting Machines.		Adding Machines.		Computing Machines.		Computing Cylinders, Tables, etc.	
	1910.	1914.	1910.	1914.	1910.	1914.	1910.	1914.
Austria	10	10	39	53	34	33	7	19
France	25	25	1	1	1	1	3	....
Germany	....	9	52	102	96	132	19	79
Luxemburg	....	....	....	1	5	5	....	....
Belgium	....	....	2	1	1	1	1	1
Holland	....	....	4	7	2	2	....	1
Switzerland	....	....	6	16	3	14	5	8
Sweden	....	....	1	1	3	4	....	....
England [1]	....	....	....	....	(4)	....	(3)	....
Denmark	....	1	....	4	....	9	....	8
Norway	....	1	....	....	....	2	....	4
Totals	35 [2]	46	105	186	145	203	35	120
Grand Total	....	....	....	....	....	....	319	555

[1] Figures for England are omitted from the totals, no reports from that country having been received for 1914.

[2] See text below.

The numbers in the table are the totals of all appliances in use in each country by the various official bureaus engaged in statistical work, whether national, district, or municipal. A brief indication of the character and origin of the devices included in each class (also taken from the *Zentralblatt*) will make the table more intelligible. Reference is made to the figures for 1914. The machines referred to in the first column include three types. The 10 in use in Austria are the old style Hollerith electrical tabulating machine, invented by the American engineer of that name and first used in tabulating the results of the Eleventh Census of the United States. They indicate by means of clock dials and do not add or print. The 11 machines in Germany, Norway, and Denmark are the improved

*See *Deutsches Statistisches Zentralblatt*, 1910, columns 117, 151, 219; 1911, column 25; and 1914, column 233.

Hollerith type, printing automatically both sub-totals and totals.* The figures given include only the tabulating machines proper, and not the complement of punching and sorting machines. A total of 402 of the latter were in use.

The 25 machines ascribed to France are of the type called *classicompteur imprimeur*, designed by M. Lucien March, the head of the statistical work of the French government, and, so far as indicated, not used elsewhere. The device serves the same general purpose as the Hollerith machine, but differs much less from hand methods. It may be described as virtually a multiple counting machine with 60 sets of rolls and as many keys, one to each set. Depressing any key counts one on the corresponding set of number discs. The keys are named arbitrarily according to the data to be recorded, either a fact or a combination of facts; for example, in population tabulation, one key might represent "males," another, "native-born males, 20–30 years," or the like. For recording more than 60 separate facts or combinations, more than one machine is used. The totals are printed at any time, by depressing a lever, and the counters all reset at zero.

The second column gives the figures for the adding machines, which are familiar in every American business office, and require little comment. Of the total of 186 reported in use in the different countries, 153, or nearly five sixths, are distributed among the following American makes: Burroughs, Comptograph, Comptometer, Comtator, Standard, and Wales. Nearly all of these print automatically, both the numbers added and the totals. The remaining 23 machines represent 10 different styles, partly foreign, partly "origin not indicated," and largely small, inexpensive, non-printing devices.

But if America may be said to have practically preëmpted the field in the first two types of instruments, the reverse is the case with the last two varieties. The "computing machines" are designed to perform all four of the fundamental arithmetical operations, but are chiefly used for multiplication and division. They all depend on the basic principle of repeated additions for multiplication and repeated subtractions for division. The 203 machines are distributed among 20 makes, all apparently foreign to the United States, and represent two general systems of arrangement, the "Thomas" and the "Odhner." At least two patterns are imported and extensively used in this country, the "Brunsviga" and the "Millionaire." The latter is a Swiss product, arranged according to the "Thomas" system, but represents an improvement over all similar machines in that the repetition of the addition and subtraction operations to secure products and quotients is automatic, the result for each figure being obtained by a single turn of a single crank handle. None of these machines print.

* For a description of the early device, see the paper by Dr. Hollerith in the *Journal of the Statistical Society* for 1894, p. 678. Some description of the improvements introduced in connection with the Thirteenth Census of the United States will be found in the *Quarterly Publications of The American Statistical Asso.* for December, 1909, and a fuller, popular account in the *Scientific American* of September 11, 1909.

The devices classed in the fourth column of the table are a miscellaneous group of left-overs and include mainly slide-rules of different patterns and "tables" of various descriptions and systems.

F. H. KNIGHT.

Cornell University.

MORTALITY STATISTICS OF RECENT YALE GRADUATES.

Yale men are decidedly good mortality risks, especially during the years immediately succeeding graduation. This conclusion is indicated by the statistical analysis that is the subject-matter of this note. The contrary view expressed by Professor Newton of Yale, that college graduates exhibit a high death rate in the first years after graduation, would not seem to be borne out by a scrutiny of the mortality record of the twenty classes last graduated from Yale College.

These twenty classes, the first graduated in 1894 and the last in 1913, aggregated 5,870 men at graduation. Their aggregate mortality from time of graduation to 1914 was 266 men, an approximate annual average of 4.5 per 1,000 risks. The annual mortality rate for males of all ages throughout the United States (registration area) in 1900 was 18.91 per 1,000, and for males 25 to 34 years of age (corresponding roughly to the mean age of these college classes during the period under discussion) 9.05 per 1,000. It is clear that these twenty Yale classes present a better record by 50 per cent. than the average group of males of their age in the United States.

This might be expected, for college men are recruited among the mentally and physically virile, from whose ranks a continual elimination process during the college course weeds out the unfit. In other words, the college graduate has been subjected to a process of highly developed artificial selection. A fairer criterion by which to test these classes, therefore, would be the expected mortality of males of corresponding age according to the American Mortality Experience Table. This table was constructed some time ago, when the general mortality was probably more unfavorable than today; on the other hand, it was based upon a medically selected class of risks, practically all of them males, and is a recognized mortality standard for actuaries today.

According to the American Experience Table, the mortality among the 5,870 men who graduated from 1894 to 1913 would have amounted by 1914 to 480 men. The actual mortality, as we have seen, was 266, or only a little over one half the expected total.

The twenty classes show considerable variations in this respect, illustrating the fact that individuals and small social units frequently display different characteristics under substantially similar conditions. The following table gives the actual and the expected mortality of each class, and the percentage of actual to expected:

Class Yale College.	Number at Graduation.	Deaths to 1914. Actual.	Deaths to 1914. Expected.	Ratio of Actual to Expected Mortality Per Cent.
1894	238	27	38.5	70.1
1895	249	27	38.2	70.7
1896	278	20	40.3	49.6
1897	275	24	37.4	64.2
1898	300	21	38.8	54.1
1899	298	27	35.8	75.4
1900	320	18	35.7	50.4
1901	253	17	26.2	64.9
1902	291	9	27.8	32.4
1903	316	19	27.6	68.8
1904	286	4	22.6	17.7
1905	288	7	20.6	34.0
1906	295	17	18.7	90.9
1907	356	12	19.8	60.6
1908	339	8	16.1	49.7
1909	310	4	12.3	32.5
1910	310	3	9.8	30.6
1911	297	1	7.1	14.1
1912	286	1	4.5	22.2
1913	285	0	2.3	—
Total	5,870	266	480.1	55.4
Average	293.5	13.3	24.0	55.4

Variations in the ratio, as among the several classes, run all the way from zero in the latest class up to 90.9 per cent. in the class of 1906. It is difficult to analyze these variations, or to explain why classes that graduated within the same five-year period, such as the classes of 1904 and 1906, differ so greatly in their relative mortality records. One may only fall back upon the well established statistical principle that the law of social averages cannot be applied to individuals or even to small groups of individuals, owing to variations in individual type. But extend the inquiry over a larger number of individuals or groups, and the social law emerges above the individual variations in type. Thus the twenty classes when reduced to five-year groups display a uniform and constant tendency, as follows:

Groups of Classes.	Aggregate Number.	Aggregate Deaths to 1914. Actual.	Aggregate Deaths to 1914. Expected.	Ratio of Actual to Expected Mortality. Per Cent.
1894–1898	1,340	119	193.2	61.6
1899–1903	1,478	90	153.1	58.8
1904–1908	1,564	48	97.8	49.1
1909–1913	1,488	9	36.0	25.0

Not only do the actual number of deaths decrease among the more recent classes, but the ratio of actual to expected deaths also decreases.

The decrease is constant throughout the four five-year groups, and is especially marked in the case of the last five classes. This seems in direct contrast to the conclusion of Professor H. A. Newton, already cited, (F. B. Dexter's Yale Biographies and Annals, 1896, Vol. 2, p. 785) that "it is a marked feature of the mortality statistics of American college graduates that there is excessive mortality in the years immediately following graduation, no doubt due to the strenuous efforts of young graduates to attain a good position in their profession, while the later favorable experience in the ages from 45 to 75 is presumably due to the fact that they have by that time gained position or else lost ambition."

This rather categorical statement was called to mind by the present writer in a note on the longevity of college graduates in the *Yale Review* for May, 1905, the statistics presented in that note seeming to bear out Professor Newton's contention. The statistics here set forth, however, run directly counter to his findings, and offer ground for further speculation and argument.

J. H. PARMELEE.

Washington, D. C.

NOTE.

Dr. Jacques Bertillon, who recently retired after long and distinguished service at the head of the municipal statistics of Paris, has now been asked by the French Minister of War to take charge of the French medical statistics of the war. The data for these statistics will be collected on individual schedules, of which 3,500,000 have already been printed and more will be needed. Thirty invalided soldiers are at work under him in classifying and counting the bulletins. The brilliant ability of Dr. Bertillon as a statistician promises to make the report, when published, one of the most authoritative sources for medical statistics in this field. Similar reports were published in France after the Crimean War and the Italian War of 1859. They were edited by a military statistician named Chenu*; but the data on which his works were based were fewer in number and more restricted in range of information than those upon which Dr. Bertillon's report will rest.

W. F. WILLCOX.

* *Rapport au conseil de santé sur les résultats du service médico-chirurgicale pendant la campagne d'Orient en 1854–1855–1856* (Paris, 1865). *Statistique médico-chirurgicale de la campagne d'Italie en 1859 et 1860* (Paris, 1869).

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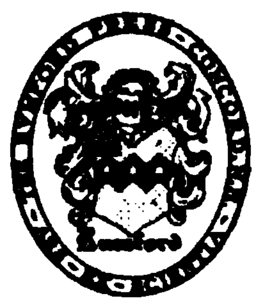

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AMERICAN
STATISTICAL ASSOCIATION

NEW SERIES, No. 111. SEPTEMBER, 1915.

THE SOCIAL SURVEY AND ITS FURTHER DEVELOPMENT.*

By J. L. Gillin, Ph.D., *Department of Sociology, the University of Wisconsin.*

Never has the world seen such a passion to apply to society the aphorism of the ancient philosopher, "Know Thyself" as we find rising in the communities of today. Statistics of some sort the world has had for a long time; statistics concerning the things about which we are gathering information today, however, until recently have been very few if not entirely lacking.

Never as now have men put the test of efficiency to political, economic, and social movements and agencies. In business, cost of production and distribution cannot longer be ignored or guessed at; they must be known. Thousands of dollars are spent by business and industrial firms every year for advice as to how the wastes of the business may be eliminated. Business organization is judged by its success in so coördinating the forces it employs that there may be the minimum of friction and waste. The efficiency movement, so-called, has produced remarkable results in commercial and industrial organizations.

The social survey is an expression of this same movement in the social as distinguished from the economic realm. The social survey is an endeavor to take stock of certain phases of the community which bear upon that community's welfare. Its methods have been borrowed, to begin with, from the commercial world in part, and in part from the methods of the census. The first great social survey of modern times was that of Charles Booth, in his *Life and Labor of the People of London*, on which he spent many years and a great fortune. It is the

* Paper prepared for the Annual Meeting of the American Statistical Association, Princeton, N. J., December 29, 1914.

most comprehensive social survey that has ever been made by a private party. The one great survey made in America by a private organization is the Pittsburgh Survey, which is not entirely published at this date. The movement has gained impetus in America by the establishment of a Department of Surveys and Exhibits by the Russell Sage Foundation, and by reason of the publicity that has been given to the results of the surveys of various magnitude in different parts of the United States. It has become almost a fad to start a social survey. Because of this popularity the survey is in danger of becoming a by-word and degenerating into a pleasant pastime for otherwise unoccupied people. On the other hand, this belief in social stock-taking supposed to be secured by the social survey, has made possible the rise of a group of professional surveyors who are endeavoring to commercialize this passion for social knowledge. These two vagaries, however, must not blind us to the possibilities of the social survey to contribute to community improvement.

Varieties of Surveys.—Social surveys vary first as to the scope of the survey and second as to the persons who may properly make the survey. The scope of the survey depends upon whether it is a survey for a small community or for a large one. It is very much easier to make a thorough-going survey of a small, simply organized community than of a large one with its complex interests, its interlocking organizations, and its immense diversity of population, economic activities, and social functions.

In the survey of small communities the effort may be to make a rather rapid preliminary survey that will produce an appreciation of the problems of the community. Such a survey can be made easily and cheaply and will serve as a working basis for a more intensive investigation of some of the significant problems discovered. On the other hand, a social survey may be a very complete investigation of the various interests, activities, industries, organizations, and phases of community life.

For the large community the social survey may take any one of a number of different forms. As in the case of the small community it may consist of a rapid, rather superficial kind

of social prospecting, confined to certain neighborhoods of the community. The purpose of this survey would be to provide a cross-section of the community life. Or the survey may be a wider investigation, but not intensive, taking in perhaps the whole community preparatory to a more complete study later. Or, it may seem best to make a complete survey of the whole city, based upon a preliminary survey by paying special attention to those phases of the city's life which the preliminary survey has shown to be of chief significance. The best example of this type is the Pittsburgh Survey. Or again, the survey may be a community problem survey. In this case, the investigation is confined to one or more specific problems in the community, such as health, recreation, sanitation, industry, etc.

The surveys differ from each other also with regard to the persons making the survey. An investigation of a community may be made by experts trained for such work. In that case the whole of the investigation would probably be made by parties from outside the city. Again, the survey may be made by certain interested persons in the community itself, under the direction of an expert. Or again, the survey may be made by certain people in the community on the basis of an outline and printed or typewritten plan prepared by experts.

Each of these plans has its advantages and its short-comings. The expert from the outside possesses the advantage of no acquaintance with the intricacies of the local situation and he can go ahead without reference to any existing prejudices. On the other hand, he suffers the disadvantage of not knowing the local situation and therefore is likely to spend a good deal of time in finding out things that are matters of common knowledge to the people of the community. The second plan has the advantage of expert direction and of local advice and coöperation. If it has any disadvantages they are incidental to the difficulty of securing coöperation between the people of the community being surveyed and the experts in charge of the work. The third plan has very narrow limitations. It cannot be used at all in large, and for only very superficial work in small communities. This method, however, serves as a possible beginning in community stock-taking, and, pro-

vided it is very carefully done, is a useful device to get people interested in a careful study of their community.

Further Steps.—The social survey has now developed to the place where it is manifest to careful observers that some further steps in its development are necessary. Certain short-comings have been complained of by its enemies, and certain others have been recognized by its friends. The difficulties of the social survey are incidental to its growth.

1. Some adaptability to the needs of various communities is now to be found in the methods of the social survey. It varies, as has already been indicated in the first part of this paper. It is felt, however, that it must be further perfected in its adaptability to the varying needs of different places and situations. The plan of a survey adapted to a small community, of course, is not adapted to a large community; neither are the methods used in making an intensive survey like those adapted to a "prospecting survey." Yet, for reasons that will be mentioned later, it is desirable that there be sufficient uniformity in the methods used for varying situations so that the results may be compared with exactness.

2. It is desirable also, that there be an improvement in the standards and units of measurement used. The technique of the survey must be further perfected. Through long experience civil and mechanical engineering have established certain standards and units of measurement which are generally recognized by all investigators in these lines. So, also, the good diagnostician has certain fundamental things concerning which he inquires in his endeavor to ascertain the causes of disease. Likewise, there are gradually developing among social surveyors certain standards for the measurement of social phenomena. These standards, however, differ somewhat from man to man, and there is lacking that agreement among social surveyors which is highly desirable. Moreover, as Miss Goldmark noticed a number of years ago, it is highly desirable that a unit of measurement in each class of phenomena investigated be more widely recognized than at present. The difficulty with the present diversity of units of the phenomena investigated makes it impossible to collate the results of different surveyors for purposes of comparison. Thus the develop-

ment of the technique of social surveying is one of the pressing needs just now. It is not intended that any hard and fast rules be laid down that shall hinder experiment at a time when social surveying is in its infancy. It is desirable, however, that those who are concerned for the perfection of the technique of social inquiry and who have had most experience in the gathering and handling of statistical data bearing upon social affairs should bring to the solution of this problem their intelligence and experience for the benefit both of the communities surveyed and of the scientific results to be obtained by the collection and comparison of data from widely different areas of our country. On the fundamentals there could well be agreement, even if there is diversity of opinion as to some of the details. The time has come when it is highly desirable that upon the fundamentals of the survey there should be general agreement, and that a body commanding the respect of students in the various fields of social phenomena should back up these standards with its prestige.

3. Incidental to the wide value which the social survey has begun to enjoy is the growth of a commercialized professionalism. Once the technique of surveying is established in a general agreement among those interested in such problems, doubtless the commercialized professional social surveyor will serve a useful purpose, just as the public accountant, the civil engineer, and the doctor occupy positions of honor and usefulness in our social life. Nevertheless, in the absence of established standards of survey work, the commercial social surveyor who depends upon his work for a living is a menace to the development of this method of social stock-taking. Now is the time to provide for the deliverance of the survey from the hands of the man who does social surveying on a commercial basis. Already in a number of our universities and colleges the social survey is established. Among these are the University of Minnesota, the University of Kansas, and the University of Wisconsin. Moreover, a number of private organizations are doing commendable work on the non-commercial basis. Among them are the Department of Church and Country Life of the Presbyterian Board of Home Missions and the Department of Surveys and Exhibits

of the Russell Sage Foundation. Besides these a number of the schools of philanthropy have devoted considerable attention to methods of investigations and supply training in social survey work. In special fields the Recreation Association of America, the Association of Societies for Organizing Charity, and a number of other bodies are doing survey work on a noncommercialized basis.

It is highly desirable that in the early development of this work the first consideration should not be the pecuniary return. The professional surveyor is likely to be open to criticism on a number of points. Too often he starts in on the social survey the victim of a pre-conceived hypothesis or of an established prejudice. He assumes that certain things are wrong. Unconsciously that conviction colors his findings. Having found certain things wrong in other communities, naturally he is looking for the same things in the community now under observation. Again, the commercialized surveyor is prone to look only for bad conditions rather than to make a correct appraisal both of the good and the evil in the community's life. He is likely to feel that he must find the evil that his employers have suspected, else he cannot justify his employment. In this respect he reminds one of the quack doctor who can secure business only by making out a bad case for the prospective patient. Such a surveyor may excite interest and secure employment for a time, but his methods are sure to bring reproach upon the whole survey movement.

Again, the social surveyor desires publicity for his work. He has learned that muck-raking secures publicity. Therefore he emphasizes the evil conditions in the community without stating them in their proper relations to the social assets of the community. Following the publication of a one-sided survey of this kind, there is bound to be a reaction on the part of those who know that the community is better than it has been painted.

Again, the commercialized surveyor, in borrowing the basic idea from the accountant and the shop efficiency expert, is prone to apply a yard stick to the measurement of ideas, to weigh the value of institutions with a clumsy steelyard, and to evaluate educational, recreational, religious, and other social

institutions by the standards of efficiency worked out in a business house or a factory. These clumsy methods and standards are bound to meet with rebuke. Who but a lop-sided social surveyor, obsessed by an idea half truth and half falsehood, can believe that the efficiency of a teacher, preacher, or a social worker can be measured by the same or even similar methods as those applied by the efficiency engineer to the foreman of a shop or the worker at a machine; or that the value of a social institution, such as a church or a school, can be determined by the number of services held in the former, or the number of hours spent in the latter? The social survey must result not merely in destructive criticism, but in a constructive program based upon a careful study of both the social assets and liabilities. Muck-raking in social surveying may have been a necessary incident to its development, but it is a question whether that necessary incident has not been also a necessary evil. Any community is justified in resenting the publication of its defects to the world unless its good qualities are set forth in as striking a manner. The ideal, of course, is that the good present should be made the basis for a constructive program to remedy the evils found. It is time that the various agencies at work at the present time on a non-commercialized basis should unite in their efforts to establish standards and methods for the social survey that will redeem it from the reproach into which commercialized social surveyors have sometimes brought it.

4. A still further step necessary to be taken that the social survey may fulfill its possible function in society is the standardization of methods so that the findings of the different surveys may be brought together for comparison. From the scientific standpoint it is highly desirable that the results of these various social investigations should be brought together in order that generalizations concerning our complex social life may be formed. Of course, the practical results of the survey are what is immediately desired by the community surveyed. Nevertheless, in the long run, the survey must provide a foundation of social fact upon which may be established principles regulating social life. Therefore, the next step is to provide for the collection and comparison of the

findings of the social surveys made in various parts of the country. To make these findings comparable, they must be secured according to uniform methods over standard units of area to be investigated.

5. If the contentions of this paper are correct, and I believe they represent the feelings of those who have watched the progress of the survey movement, then there should be organized a body representing the various groups of people interested in the social survey. This body of men should devote themselves to a study of the survey as it exists at the present time, suggest methods by which its defects may be removed, its technique perfected, and its results correlated for a larger purpose. The American Statistical Association, the American Sociological Society, the various private organizations doing survey work, and the colleges and universities should organize a joint standing committee on surveys and statistics to see that these steps are taken as rapidly as possible. So important an agency for the social welfare must not be exploited by selfish men for their own private gain in such a way as to destroy its usefulness. A standing committee formed from these bodies already mentioned should aim not only to report on what is being done in various parts of the country, but should formulate standards and methods on which all could agree in order to give advice and help to persons engaged in social investigations. In this way the coördination of the agencies already existing could be obtained in the great work of making the social survey of the greatest possible usefulness in ascertaining the facts touching our social life, in working together on a constructive program for community betterment, and in preventing the abuses which sometimes have grown out of ill-advised efforts at social investigation and community betterment. What good reason is there why such organizations as the great philanthropic and scientific foundations, the universities and colleges, important national bodies like the Statistical Association, the Economic Association, the Sociological Society, and perhaps representatives from such national bodies as the Federal Industrial Relations Commission, the Bureau of Labor Statistics, etc., could not coöperate in giving the social survey movement direction as well as impetus?

DATA ON UNEMPLOYMENT FROM EMPLOYERS' RECORDS.*

By Howard Woolston, Ph.D., *Director of Wage Investigation for The New York State Factory Commission.*

Mr. Chairman and Gentlemen.—In a busy office an inquiring statistician is as welcome as a skeptic at a revival, and is frequently consigned to the same fate—conversion or perdition. The firm may have established a system of records so complex that the junior partner cannot study the sporting sheet before noon, because of the reports that accumulate upon his desk. Or a recent lecture on efficiency may have so impressed the manager that he drives the book-keeper to profanity by requests for information upon man-hours, per capita output, inventory and depreciation. An enthusiastic business man at luncheon will bore you to exhaustion with details of discounts and commissions. But present yourself the next day with credentials from the state and ask for data from his pay-roll, and this same genial person fixes you with a cold stare and demands what plot of political burglary you are attempting to abet. It is like an unsolicited call from the doctor—a shock to the unwilling but not unsuspecting patient. In other words, industry generally does not wish to have its statistical symptoms made public.

As a matter of fact, the average business man is not directly concerned about the facts of *unemployment*, nor do his records immediately show conditions in this respect. He knows how many persons were *employed* in his factory at any given time and how many places are now vacant. But he could not tell you offhand how many different individuals have been taken on during the course of a year or what has become of those who have been dropped. Modern industry counts upon the possibility of hanging out a sign, "Girl Wanted," and getting a score of applicants. What happens to those who are laid off at the end of the season does not worry it overmuch. Employers are usually more interested in output and wages than in vagrancy and pensions. Relatives, philanthropy, or

*Address before the quarterly meeting of the American Statistical Association, Yale Club, New York City, April 17, 1915.

Merciful Providence are supposed somehow to haul in the slack. Business is business; not an asylum. So what do you expect?

Of course you know the appalling waste of this policy of keeping business clean by allowing it to throw its human refuse into the streets. You appreciate the social cost of permitting industry to scrap its useless personnel at the expense of the public. Some employers are also beginning to see that this is poor management, and are trying to organize a system for adjusting their human machinery, just as they have engineers to look after the management of the plant and its equipment. They are beginning to follow with care the records of their workmen and to place them where they can be employed steadily and efficiently. Indeed, efficiency seems to demand steadiness, for a temporary worker loses speed, deftness, and ready judgment in handling material.

How great the loss from disorganizing a staff of workers and breaking in new hands may be, we do not know. The extent of seasonal fluctuations and individual shift have been discovered. For instance, the Factory Commission found yearly variations of 30 per cent. and 40 per cent. in the working force of comparatively steady industries in this state. Twice as many workers are added and dropped annually by individual firms as are usually employed. This displacement is more serious than the figures suggest, because only about one fifth of the workers are steadily employed throughout the year, while more than one half of all remain with the same firm less than three months out of twelve. Of course this shifting about involves loss of time between jobs. Out of 1,500 women interviewed regarding this matter, 1,000 had lost time during the preceding year. This amounted on the average to more than one month for each of them.

These figures indicate some of the data that can be obtained from the records of employers. One of the most profitable sources of information in these matters is the register of employees kept by some firms: In the better establishments this is generally in the form of a card catalogue, containing the main facts presented on the application, such as the name, address, sex, age, birthplace, previous experience, and former

employers. To this information is usually added the date of engagement, department or occupation to which the person was assigned, rate of wages on beginning, together with subsequent transfers, and date of leaving with reasons therefor. Such files are mines of information regarding the industrial history of workers, their advancement, replacement, and the *steadiness of their employment.*

Unfortunately many firms do not keep an adequate register of employees. In some cases a factory hand is known only as "Joe," or "Number 539." The original number is frequently changed or the worker is shifted to another department without recording this fact. It is then almost impossible to identify "Joe" among three or four persons of the same name or to trace "Number 539" with any certainty that the same individual is being followed. I recollect an instance of a man in a Pittsburgh mill, who was absolutely volatilized by the overturn of a bucket of molten steel. His relatives sought compensation from the company. But his name was not opposite the number assigned to the dead workman. There were literally no remains to identify, and so the man simply disappeared—lost in the records of the mill.

Very often the home address given by employees is false or has long been changed. This frequently occasions misunderstanding as to living conditions or causes delay in receiving official communications. An outbreak of smallpox appears in an Italian lodging house where several hands in a local chocolate factory live. Records of the firm show no such address for any of its employees, and the questions of the visiting physician are answered evasively. The first intimation the cocoa manufacturer has that his workmen have been bunking next to an advanced case of the disease, is when, after a brief absence, one man yells because his neighbor has struck his recently vaccinated arm.

It seems very important that every employer should keep a proper registry of all persons who work for him. This would insure correct identification of employees whose domicile, citizenship, majority, occupation, means of support, and past experience might be questioned, and for whom the firm might prove in some way responsible. Such a record is now required

for certain classes of employees, but it should be demanded for every worker in an establishment. This seems to be a proper measure for those of you who are interested in adequate labor statistics to frame and to urge. Certainly uniform records containing such information would greatly simplify the work of labor authorities in tracing industrial histories, and would enable them to know for a certainty who had been employed by a given firm.

In many cases the pay-roll is the only record of employees. It generally shows for each date of payment, the number of persons working and the earnings of each for the preceding period. This, of course, is our main source of information regarding employment. But the way these records are kept would harrow your orderly souls. Some are in the pocket memoranda of proprietors. In other cases a weekly sheet is made up and then thrown away. The better firms have beautiful loose-leaf books, showing opposite the name of each employee for a number of weeks the rate of wages, time worked or pieces turned out, additions, deductions, and total earnings. From such records one can readily follow the fluctuation in employment and wages.

Here again, it seems important that a body such as this should concern itself to secure the keeping of proper records. Without them, we can have no adequate statistical data. The matter of days or hours employed, or of output for piece workers, is fully as important for an understanding of the state of industry as is a figure giving the number of persons at work and their rates or actual payments. During a slack season half the workers may be on part time although nominally employed, or extra hands may be engaged for a few hours a day during a busy period. These facts would pass unnoticed in a general statement of total persons employed. I hope that some of you with an interest in scientific book-keeping will suggest a simple, uniform pay-roll, time sheet, and record of output that may be urged upon progressive employers.

But finally, the extent and causes of unemployment can never be studied properly until we secure uniform periodic reports from large numbers of employers. This, it seems to me, the state should require at short intervals in order to

supplement the work of the federal government. The general form used by the Census authorities or that required by the Massachusetts Bureau of Statistics offer good models to follow. Perhaps a statement of persons employed each week and total payments to the same would form a desirable basis. The addition of a simple classification of the number of persons receiving specified wages would enormously increase the information conveyed.

It is desirable also that such reports should give not only the number of persons employed at any time, but the number of individuals who have been added or dropped by the firm during a certain interval. This shows the fluidity of the labor market, which is quite as important as an index of its general rise and fall. In stock quotations we want to know not merely the current price, but also how many shares changed hands at that figure. In weather reports we ask not only the barometric pressure but also the direction and velocity of the wind. So in labor reports we should be able to find not merely how many workers have jobs at a given time, but how long they can hold the jobs.

Through the active interest of a group such as this, adequate returns from employers as to the state of their business might be secured. Many men of affairs would welcome a thorough-going study of the labor market and would do their part to make it possible, if they were assured that the returns would be dealt with in a strictly scientific manner. Employers now resent the duplicate demands of several authorities, and view with suspicion the efforts of any administration to investigate the details of their business. This unwillingness to submit to what is termed "political interference" may be justified, since one administration may establish a system of returns and the following one may reconstruct the whole plan. If, however, a national body of scientists and practical men would establish standards and insist upon their being followed, much of this unwillingness to supply information would be removed.

The federal government has already done much to secure the coöperation of representative firms throughout the country in this matter of reports upon business conditions. The

states have not all been equally successful. But if their work could closely follow that of the national authorities and articulate with it, there is no reason why the country might not be covered with a net-work of centers for gathering accurate and timely information.

You know how the system of labor exchanges in Germany was established largely through the efforts of a few men who gradually brought together various agencies throughout the Empire. With the help of the national and state authorities represented in this society, there is no reason why we may not hope soon to organize a scheme of intelligence bureaus that will cover this country. Their bulletins of information for each region will soon become invaluable to large employers of labor, who will study them as carefully as the quotations of the produce exchange and the statements of the banks. For labor, after all, is the most important single factor in business; and once business men have learned that the movements of the labor market can be rationally followed, predicted, and controlled no group in the community will be more eager to help in the adjustment of its problems than the fair-minded employers of America.

But the problem of unemployment is too difficult for any class in the community to deal with out of hand. We have long since ceased to hope that passing the hat and taking up a collection for the man out of work will serve as a solution. The relief funds of charitable agencies and trade unions can not sustain a growing number of dependents at times when their contributions fall off. It is useless to ask employers to furnish additional jobs when their business is inactive. And by a bitter irony of fate, the administration cannot undertake public works because its resources also are straightened during periods of industrial depression. Here, then, is a desperate situation that recurs with increasing acuteness. What can be done?

This appears to be a problem of the sort that an actuary tackles when he calculates the cost of insuring during periods of productivity the lives and health of men who are bound to fall ill, grow old, and die. The business world must somehow be brought to distribute and adjust the burdens of adversity during its periods of prosperity.

But what actuary would attempt to fix any insurance rate without careful study of the experience of large numbers of cases at risk for long periods of time? Here is where the statistician must help by collecting a sufficient body of reliable data. And who are better able to furnish the facts regarding the cycles of trade than employers, whose demand is the stimulus of the labor market?

When these men can be brought to see that by pooling their experience they can furnish the basis for a scientific solution of this problem, I believe they will not be slow to do so. And when, as a plain business proposition, they understand that lessening unemployment means lowering charges upon industry, I am sure they will take rapid and effective measures to bring order and regularity into the erratic and irresponsible conduct of their fellows.

THE VALUE TO ECONOMICS OF FORMAL STATISTICAL METHODS.

By Carl J. West, Ph.D., *Ohio State University.*

To afford an accurate form of summary statement of economic facts and changes, statistics must present the facts in such a way as to enable the mind to grasp them as a whole more readily and clearly. From this point of view the chief care of the statistician is to secure accurate and comprehensive field-work or counting. As a recorder and tabulator of economic data he can consider his work done either when each individual instance has been enumerated or when a definite estimate can be made of the per cent. of accuracy.

But economics demands that statistics do more than serve as a sort of bookkeeper. It is only by a study of the statistics that causes and relations can be suggested and the basis laid for empirical laws. The complexity of our economic relations requires the economist to keep in constant and close touch with concrete facts.

To what extent the prevalence of a certain disease depends on the climate or the season and to what extent on the state of sanitation can in general be determined only from an extensive statistical investigation. The intricate questions concerning the rise and fall of the interest rate are largely matters of dependence among different series of statistical facts. A general theory of prices and the gold supply needs empirical verification at every point. The fluctuations of wages and the movement of retail and wholesale prices can not be adequately understood until better and more accurate data can be obtained. Immigration and business prosperity and depression, the consumption of alcohol and the presence of poverty are essentially questions of the effect which variations in one condition or characteristic produce in related attributes or conditions.

These illustrations suggest the rather evident fact that the logic of most problems in economics is essentially the same. The ultimate aim is of course to detect and demonstrate causal

relations. The limitations or requirements of the problem may render it undesirable to attempt a more detailed formulation of the causal statement than of the type: If cause or event A is present then effect or event B will follow; or negatively, since A is not present or does not vary when B varies in value or degree of intensity, A can not be the cause of B. In general, however, the description of the causal relation can not be considered satisfactory until it is possible to state in detail just what change in the effect will follow from certain definite changes in the cause. Thus causal relations fall naturally into two broad divisions according as the characteristics or attributes are accurately determined and measured in detail, or are not measured further than to enumerate the cases in which each is present or absent.

For the purposes of statistical economics, characteristics or occurrences may be said to be causally related when, *other things being equal,* the presence of a definite amount or degree of the one is always accompanied by a corresponding amount or degree of the other; so that, in general, if one changes the other changes and if one is present and acting, a corresponding effect is to be noted in the other.

The physicist, the chemist or the engineer can make direct use of this definition since it is often possible, within working limits, to hold all other conditions constant while the conditions under consideration are varied. The engineer can so arrange his experiments that discordant and irrelevant elements can be avoided, as, for instance, when the distinct strains that a steel beam undergoes are reproduced in the laboratory and the effects measured.

But the material of the economist in degree, at least, is radically different from that of the student of the so-called exact sciences. The data of the former is always heterogeneous and complex so that it is not possible to isolate the variations and observe their relations directly; neither can it be safely assumed that all other conditions are constant while the conditions studied vary or change. For these reasons the comparatively simple and direct methods of those sciences will not apply to the solution of the problems of statistical economics. The social scientist requires methods for discovering and

demonstrating the presence of definite and uniform *tendencies* for variations in one condition or characteristic to depend on the changes in certain other conditions; that is, *correlation* methods which deal with measurements *en masse* rather than as individuals.

Thus, to test the obvious fact that during the earlier years stature increases with age, the height of 1,000 individuals at ages ranging from 6 to 25 might be determined and the average height for each age computed. In the midst of the disconcerting variations due to lack of homogeneity in conditions of health, parentage, environment, posture, etc., the general tendency for tallness to accompany heaviness would be apparent in the data.

For the treatment of the essentially *mass-aggregate* or *group* problems of *statistics* which have to do with collective and not with individual measurements, a body of theory having the definite and systematic form of the other mathematical sciences has been developed. Owing to its having been first developed for the problems of biology, however, there is need in some respects for adaptation to the requirements of the social sciences.

Every economist who makes use of concrete statistical facts must form collective judgments, must rely largely upon correlations to point out causal relations regardless of whether he consciously and formally makes use of the terminology and methods. As an illustration of a simple type of question which can not be answered by the use of informal methods take the following data of the Sheffield smallpox outbreak of 1887–1888 as given by Dr. Macdonell:*

VACCINATION–STRENGTH TO RESIST SMALLPOX WHEN INCURRED.

	Recoveries.	Deaths.	Total.
Present	3,951	200	4,151
Absent	278	274	552
Total	4,229	474	4,703

This table shows clearly that in this instance vaccination was highly effective in combating the disease. But sup-

* Elderton, *Frequency Curves and Correlation*, p. 125.

pose the same statistical material were reclassified on the basis of the presence or absence of a characteristic which we may call "sanitary" and that the following distribution was obtained:

"SANITARY"–STRENGTH TO RESIST SMALLPOX WHEN INCURRED.

	Recoveries.	Deaths.	Total.
Present	3,850	195	4,045
Absent	379	279	658
Total	4,229	474	4,703

Apparently this measure or condition is about as effective as vaccination so that it is a matter of careful study to decide which has the higher efficiency; no casual method can be relied upon to yield a satisfactory answer.

The inadequacy of informal methods may be further illustrated by the difficulty of properly "smoothing" a series of measurements by generally loose methods. To know what variations are accidental and what are significant requires first of all a thorough knowledge of the data, and to successfully eliminate the irrelevant or accidental elements without sacrificing the truly significant variations considerable skill in highly technical methods is necessary. The following table of the measurements of stature of a class of students furnishes material for an illustrative problem in "smoothing."

Stature	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74
Frequency	1	2	2	11	11	48	45	97	100	126	103	97	45	46	4	1

In these measurements one would suspect for instance that the comparatively large numbers having stature of 72 and 70 inches were not significant. The equal frequencies for 62 and 63 inches are also to be noted.

Economists have done little "smoothing" or other refining of their data for the reason that *they have not attempted to utilize more than a very small part of the information it might be made to yield.* Were it the object of this paper to discuss the value of individual methods and processes the idea of the "probable error" and of the various measures of correlation

would be illustrated. But enough has been given to show the general value and especially to suggest what is doubtless the most important value of formal methods for economics: *that if economics is to make use of more than the most obvious statistical facts and relations it must employ methods adequate to the bringing out of the significance of the data.*

It is not meant to imply that an elaborate formula is always or even ordinarily essential to the demonstration of a conclusion in statistics. But the statistician and economist should be acquainted with the general methods in order to obtain the advantages of sharply defined technical concepts and of systematic and generally accepted habits of thinking and ways of attacking a statistical problem. Only then can it be correctly decided, for example, when the most superficial methods of estimating causal connections are sufficient; when graphic methods give results with all the accuracy that the data warrants or the problem in hand demands; and when it is advisable to employ more detailed and exact methods. *Thus the economist has need for a science of statistics similar to the need of the biologist for chemistry and microscopic technique and of the engineer for physics and mathematics.*

An extensive employment of statistical data means that the material must be collected as representative or typical data and not by complete enumerations. The expense and labor involved render the second method prohibitive, and besides few objects of economic inquiry lend themselves to the process of complete enumeration. Indeed, much can be said in favor of the argument that better data for the purposes of economics can be obtained by carefully selecting the material. Moreover, though the data may be gathered by an exhaustive process of counting it must be considered as typical, as a true pattern of what may be expected to occur again and again under similar conditions, if it is to be of value in establishing a principle or verifying a deduction. Reliable and effective work with typical data can not be done without an extensive acquaintance with statistical theory. For this reason, if for no other, statistical economics can not be developed to a significant extent until methods adapted to its peculiar needs have been worked out and popularized among economists.

It may well be asked what effect the introduction of more formal methods may tend to have on the quality of the empirical work of economics and on the effectiveness of economic work in general.

Accuracy in the collection or production of statistical facts and accuracy in determining and stating the degree of confidence that can be placed in the data is a matter of fundamental and vital importance for economics. The statistician who realizes how little has been done in this respect and how difficult it is to secure proper appreciation of the necessity for extreme carefulness and caution in accepting statistical material may well feel apprehensive of the effect of the introduction of new and apparently easy methods of deducing striking results. Perhaps the most suggestive way of estimating the probable influence of the extensive adoption of statistical methods on the quality of the data is by studying the conditions which somewhat similar circumstances have produced in other sciences. It is also of interest to note the working relations that have gradually grown up between the experimental and empirical elements on the one side and the so-called theoretical parts on the other.

The development of profound mathematical methods in physics has not tended to lessen the accuracy of the laboratory work but to increase it. On the somewhat slender basis of Hertz's experiments, Maxwell produced his mathematical theory of electromagnetism and ether waves. On the basis of and as a result of this theory, Marconi invented the wireless telegraph. This working together of theory and experiment along with the feeling that no result can be accepted until it has received both theoretical and experimental verification is of definite and positive significance for economics. If the two aspects can get on so well in the field of physical science, why not in the social sciences?

Psychology is similar to economics in that it deals with data subject to large variations in the individual measurements so that only aggregate methods can be employed. There is much discussion among psychologists regarding certain points of method, but it is generally agreed that experimental results must be reduced before they become completely intelligible.

An important consideration from our point of view is that the introduction of somewhat complicated methods for determining correlation and variation has stimulated both the production of experimental data and the critical discussion of such data, which can but result in better and more accurate experimental work. Moreover, the results in psychology tend to show that not only is the accuracy of the observational work increased but also the science itself is greatly enriched by the introduction of formal methods of reducing the statistical data.

The history of biology since the time of Darwin is especially instructive. Darwin, both by his example and by the stimulating influence of his work, gave great impetus to observational methods in biology. The researches that have resulted consist essentially of studies in the comparative variations among different biological classes and of the inter-relations of such variations. These variations are often small so that appropriate and adequate methods of dealing with the peculiar problems of the data are imperative. Professor Pearson in his "Mathematical Contributions to the Theory of Evolution" developed the working rules and principles which have been almost universally adopted by statistical biologists. Since so much of this statistical work is largely routine in character the results have been satisfactory on the whole even though few biologists have the mathematical training to understand the formulas.

However, the extensive employment in this mechanical fashion of highly developed but little understood methods very naturally has resulted in mistakes which if not so serious would be ridiculous in some instances. Using six- or seven-place logarithms with data subject to a high per cent. of error; smoothing curves by methods involving an overwhelming mass of arithmetic when a better curve could be obtained by simple graphic means; failing to realize that the "probable error" is a safe guide only for homogeneous data; losing sight of the necessary limitations of the theory of the coefficient of correlation, are only a few of the statistical sins which some biologists have committed in the name of scientific methods.

Aside from the useless expenditure of labor, computing to

so much greater length than the data warrants would not be a matter of great concern were it not for the fact that such a show of accuracy is often positively misleading. The wide margin of error in the original data is presently forgotten and the results taken with all their apparent accuracy.

A class of scientists trained, as are the biologists, in systematic thinking would not be guilty of such loose reasoning if they thoroughly understood the methods they were using. Nothing but mere routine and that only when done under immediate and responsible supervision can be safely trusted to persons with inadequate preliminary training. The statistician should not make use of a formula or method until he thoroughly comprehends the assumptions on which it is based and until he knows the conditions and limits of its validity. *And further, a formula should not be used unless the results derived by it can be clearly interpreted in terms of the initial data and conditions.* The biologist and economist can safely call upon the mathematician to derive the formulas which make it possible to pass from the raw data to the finished result, but the mathematician can not always be trusted to estimate the accuracy in the raw data themselves or to tell what formulas are the most appropriate under the given circumstances; this absolutely essential part can be done only by one who is thoroughly conversant with the statistical material and who has at least a reasonably comprehensive idea of the methods.

Thus the effect on the scientific character and value of the inductive or experimental work in those sciences in which there have been applications of formal statistical methods seems to give no ground for a fear that the quality of the statistical work in the social sciences will be lowered by careful and systematic use of more standardized methods. Aside from the support which a study of the history of the other sciences may lend to this conclusion, it is logically sound to expect that the character of statistical work will improve as more attention is given to technical principles. It is only by the building up of a body of systematic principles and methods that a subject of study can be raised to the dignity of a science. The mere fact of the existence of formal methods imparts a definiteness which tends to stimulate systematic thinking even though

the actual methods are not consciously or formally made use of. Besides there is always a gain in doing routine and detail work according to orderly, systematic, and generally accepted methods. For instance, the consciousness that the methods employed have been tried and proved produces a confidence in the results which can be obtained in no other way. The too frequently encountered opinion that one "can prove anything by statistics" is due partly to the lack of generally recognized methods of measuring the degree of connection between related series of events, and partly to the failure to critically value the reliability of the data, and much of this failure is due to the lack of simple but uniformly applicable methods of measuring such reliability. The non-technical person is quite ready to rely on the conclusions of specialists provided the specialists are reasonably agreed among themselves. But with methods as tentative and dependent on personal peculiarities as are the ordinary methods of statistics such an agreement is impossible.

An increased appreciation of statistical work is bound to react favorably on social science in general. It is possible that economics should become more professionalized than at present. Most individuals of average intelligence would assent to the statement that the trained economist is better able to decide complicated economic questions than are they themselves, but if it came to a matter of personal concern it is doubtful whether the opinion of the specialist in economics would be held in such respect as would that of the physician or lawyer. While there is no particular reason for thinking that formal statistical theory can or should become popular in the generally accepted sense of the term so that anyone could make use of it, yet by giving to statistics, and hence to much of economics, uniformity of method and quantitative definiteness, making possible more elaborate and thoroughgoing investigations, the science would become more professionalized with a consequent increased respect for economics on the part of the public.

However, economics can not hope to escape the experimentation of those who are fascinated by the possibilities of the newer developments in statistical methods but who do not adequately realize the inherent limitations of their data or who do not have sufficient acquaintance with the working

principles of the methods to use them discriminately. To do trustworthy and effective work in statistical economics, the economist must be a statistician, and especially must understand the material from which the data are taken and must know the degree of confidence that the data warrant. To determine the accuracy of the data and to so analyze the numerical facts as to obtain the maximum amount of information from them requires an extensive training in somewhat complicated arithmetic and theory.

But there are few economists with the mathematical equipment necessary for statistical purposes and still fewer mathematicians with an appreciation of the problems of the economist. The physicists have adjusted themselves to a similar situation so that most physicists know considerable mathematics and usually the mathematical student has turned to physical science for a minor study. While this arrangement has worked well for the science in question persons so trained are not particularly qualified to take up statistical investigations. The material of the social sciences is so radically different from that of the physical sciences that it is extremely hard for the physicist, for instance, to adjust his habits of thinking to the new standards. It is very easy for five-place standards of accuracy to be in this way carried over into a field where the figures may often have a margin of error of several per cent.

If students of mathematics are encouraged to take up economics and the more statistical parts of social sciences in general as secondary subjects, great improvements and simplifications in statistical methods will be possible. Only in this way can the economist obtain the aid which experience in other sciences shows to be necessary.

On the other hand, the student of economics must be better trained in mathematics; not so much in the material which makes up the greater part of the courses in mathematics as planned for engineering students as in courses having the needs of the social sciences more in view. Such a course should include detailed practice in algebraic manipulation and in certain especially useful topics of analytic geometry and should lay emphasis on the subject of probability. It is no doubt ad-

visable to have a separate course for the more technical topics of statistical methods such as the smoothing of data, curve fitting, measures of accuracy, correlation, etc. With these two courses students not desiring to specialize in statistics can obtain a fairly comprehensive knowledge of statistical methods by taking the technical course only, while the student expecting to make considerable use of statistics would of course need the more extensive mathematical training.

The relative extent of these two courses should probably vary to accord with local conditions and requirements. It seems quite certain, however, that the practice of devoting a few lectures to the more technical phases of statistical methods in connection with courses in economic statistics can not be productive of results of great value, because such courses are ordinarily given by persons primarily interested in some phases of economics and consequently not likely to have great interest in so characteristically formal a study as statistical methods or mathematics; and because the subject is too extensive and complicated for so brief a presentation. The slight acquaintance gained in this way may indeed be a positive detriment if it does not impress the student with the extent and difficulty of the theory and with the necessity for extreme care and caution in its application. It is easy to lose sight of the fact that a discriminating statistical judgment can be attained only by long training and practice.

It would seem therefore that the most desirable arrangement is for the course in statistical methods to be given by an instructor who is especially interested in methods and formal theories and who has had the benefits of an appropriate mathematical training, and for this course to be followed by the courses in economic statistics and the other courses in social science which make use of statistics and in which formal methods can be employed to advantage.

INFANT MORTALITY AND THE SIZE OF THE FAMILY.

By Henry H. Hibbs, Jr., *Sometime Fellow in Research, Boston School for Social Workers.*

The influence of the birth rate on the rate of infant mortality has been frequently pointed out. Newsholme in his recent report to the English Local Government Board notes "the connection often observed between a high birth rate and a high rate of infant mortality."* Phelps, also, in his study of Infant Mortality and Its Relation to Women's Employment, states that in Massachusetts cities a "more direct relationship exists between infant mortality and the birth rate . . . than infant mortality and the employment of women," although in neither case, as his figures bring out, is the relationship invariable or even close.† The Director of the Statistical Service of France, on the other hand, has shown from an investigation made in 1907 by the Superior Council of Statistics that whatever relationship there may be between the birth rate and the infant mortality rate in cities or countries there is a very close relationship between the birth rate in families—or, what is practically the same, a close relationship between the size of the family and the rate of child mortality. It is not possible from the figures given in his study to separate the statistics for infants under one year of age, but by considering only the period from 1901–1907 it will be possible to secure a group with a maximum age at death of six years. This is done in the following table, which shows the mortality rate for infants whose fathers were employed in the public service of France according to their order of birth, or, in other words, according to the number of previous births in the family:

*Great Britain, Local Government Board, Supplement to the Thirty-ninth Annual Report, p. 49.

†Phelps, Edward B., "Infant Mortality and Its Relation to Women's Employment—A Study of Massachusetts Statistics." In Volume XIII, Part 1, of the Bureau (Now Department) of Labor's Report on Condition of Women and Child Wage Earners in the United States, p. 38.

TABLE I.

MORTALITY RATE PER 1,000 BIRTHS AMONG CHILDREN WHOSE FATHERS WERE EMPLOYED IN THE PUBLIC SERVICE OF FRANCE CLASSIFIED ACCORDING TO ORDER OF BIRTH, 1901-1907. (a)

Order of Birth.	Number of Births.	Infant Mortality Rate.
First born	25,102	113.7
Second born	21,384	121.5
Third born	14,675	139.4
Fourth born	9,750	148.5
Fifth born	6,430	165.2
Sixth born	4,251	173.2
Seventh born	2,783	186.5
Eighth born	1,842	204.5
Ninth born	1,215	187.7
Tenth born	826	236.2
Eleventh born	455	248.4
Twelfth born and over	687	276.6
Total	89,400	138.3

(a) Compiled from Lucien March's "Some Researches Concerning the Factors of Mortality." Journal of the Royal Statistical Society, Vol. LXXV, Part 5, p. 519. (Cf. Appendix.)

This table shows a strikingly close relationship between child mortality and the order of birth, the rate having increased from 113.7 per 1,000 births among the first born children to 276.6 among those who were twelfth born or over.* As has just been stated the relationship shown in this table is between the order of birth and the rate of mortality for children under six years of age. The New York Free Outdoor Maternity Clinic has recently published data collected during the first nine years of its work which show the relationship between infant mortality and the number of children to which the mother has previously given birth—a classification for all practical purposes identical with that in Table I, based on the order of birth.

*The only exception to the regular variation of the mortality rate with the order of birth was in the ninth group but this is not a serious exception, as it may be due to chance.

Dr. Alice Hamilton of Hull House, Chicago, in a recent article, "Excessive Child-bearing as a Factor in Infant Mortality" (Proceedings of the Conference on the Prevention of Infant Mortality, New Haven, 1909, pp. 74-80), shows a similar relationship between the order of birth, or size of the family, and the mortality rate for children under three years of age. Thus, among 1,600 infants born to mothers classified according to the number of children in their family the mortality rate per 1,000 births was as follows:

4 children or less	118
6 children or more	267
7 children or more	280
8 children or more	291
9 children or more	303

Among the Berlin working class Hamburger's investigation has also shown how serious a cause of infant mortality large families may be. (Kinderzahl und Kindersterblichkeit. Die Neue Generation, August, 1909). Quoted in Havelock Ellis' "The Task of Social Hygiene," pp. 150-1. Space does not permit the quoting of his figures in full.

TABLE II.

MORTALITY RATE PER 1,000 BIRTHS FOR INFANTS BORN TO MOTHERS COMING UNDER THE OBSERVATION OF THE NEW YORK FREE OUT-DOOR MATERNITY CLINIC, CLASSIFIED ACCORDING TO THE NUMBER OF PREVIOUS CHILDREN BORN TO MOTHER. (a)

Number of Previous Children Born to Mother.	Number of Births.	Infant Mortality Rate.
Less than 4	1,182	77
4 to 7	1,064	127
8 and over	294	170
0	97	10
1	288	66
2	369	81
3	428	96
4	356	127
5	354	189
6	203	163
7	152	105
8	135	207
9	90	166
10 and over	69	275
Total	2,540	124

(a) Compiled from the First Annual Report of the Free Out-door Maternity Clinic, Covering the First Nine Years of the Clinic's Existence, New York, 1910: Chapter 2, Part 2, Report of the Pediatric Department with a Study of Early Infant Mortality, by Herman Schwarz, M.D., pp. 42-3.

Table II shows a very close relationship between the number of children to which the mother has previously given birth and the rate of infant mortality during the year under consideration. Thus, the mortality rate rose from 77 deaths per 1,000 births for infants born to mothers who had previously given birth to less than four children to 170 for the infants whose mothers had given birth to eight or more.*

In the investigation by the Children's Bureau of infant mortality in Johnstown, Pa., the data gathered bearing on the relationship between fertility and the size of the family and infant mortality were classified according to the order of birth; but, as has already been shown, the terms "order of birth" and "number of the mother's previous pregnancies," though not absolutely identical, may be considered as practically so for our purpose.

*The exceptions to the otherwise continuous relationship of these mortality rates with the number of children to which the mother had previously given birth which appear when, as in the lower part of the table, each group is considered separately, will be discussed in connection with a later table showing similar data gathered in the Boston investigation.

TABLE III.

MORTALITY RATE PER 1,000 BIRTHS FOR INFANTS INCLUDED IN THE JOHNSTOWN INVESTIGATION CLASSIFIED ACCORDING TO THE ORDER OF THEIR BIRTH.(a)

Order of Birth.	Number of Births.	Infant Mortality Rate.
First and second born	622	138.3
Third and fourth born	400	143.2
Fifth and sixth born	241	177.0
Seventh and eighth born	137	181.5
Ninth and later born	91	201.1
Total	1,491	149.9

(a) U. S. Children's Bureau: Infant Mortality—Results of a Field Study in Johnstown, Pa., Based on a Calendar Year, by Emma Duke. Washington, 1915, p. 51. Hereafter this report will be referred to by the briefer title—Infant Mortality: Johnstown, Pa.

Thus, in Johnstown a relationship appears to exist between fertility and the size of the family and the rate of infant mortality similar to that shown in previous tables for other investigations:*

It is obvious that in this relationship between infant mortality and the order of birth, or the number of previous children to which the mother has given birth, there are two distinct factors present—that of the size of the family in which the child lives after birth and that of fertility in its narrowest sense, including primarily the physical influence of childbearing upon the mother and upon the chances of survival of subsequent infants to which she gives birth. Better expressed, this relationship is brought about by the influence of both prenatal and postnatal conditions on infant mortality. With this in view an attempt was made in an investigation made in 1910 and 1911, by the Research Department of the Boston School for Social Workers, to take account of both of these factors and as far as possible to measure the influence of each.†

*For other figures showing the relationship between infant mortality and the order of birth in the family see—R. J. Ewart, "The Aristocracy of Infancy and the Conditions of Birth," Eugenics Review, Vol. III, p. 166.

†The data collected in this investigation have not been before published. A brief description of the investigation would, therefore, be desirable if space permitted. Visits were made to the homes of 2,063 infants (stillborn infants not included) who were born in 1910 in Wards 6, 8, 13, and 17 of the city of Boston. The birth and death records were copied from the files of the Registry Department of the city and the visits to the homes made by fellows in the Research Department of the School for Social Workers during the academic years 1910–1911 and 1911–1912. During the second year of the investigation this field work was supervised by the writer under the general direction of Dr. T. W. Glocker, director of the Department of Research. The writer in using these data for publication wishes gratefully to acknowledge the interest and coöperation of the fellows who made the visits to the homes, as well as that of the director of the Department of Research. He is also indebted to Dr. J. R. Brackett, Director of the School for Social Workers, for permission to use the data in this way.

The method used was that of dividing the infant deaths into two groups, those reported as due to the diseases of early infancy and congenital malformation and those reported as due to all other causes—the former group being largely dominated by prenatal and the latter by postnatal influences—and showing the relation of the number of the mother's previous pregnancies to the infant mortality rate for each group. These figures are given in the following table, which shows the infant mortality rate per 1,000 births from all causes, from the diseases of early infancy and congenital malformation, and from all other causes for infants classified according to the number of their mother's previous pregnancies:*

TABLE IV.

MORTALITY RATE PER 1,000 BIRTHS FROM ALL CAUSES, FROM THE DISEASES OF EARLY INFANCY AND CONGENITAL MALFORMATION COMBINED, AND FROM ALL OTHER CAUSES FOR INFANTS BORN IN 1910 AND VISITED IN THE HOUSE-TO-HOUSE INVESTIGATION IN BOSTON, CLASSIFIED ACCORDING TO THE NUMBER OF THEIR MOTHER'S PREVIOUS PREGNANCIES.

Number of the Mother's Previous Pregnancies.	Number of Births.	Infant Mortality Rate per 1,000 Births from—		
		All Causes.	Diseases of Early Infancy and Congenital Malformations.	All Other Causes.
Less than 5	1,533	120.0	29.4	90.7
5 to 9	475	134.7	33.7	101.1
10 and over	53	226.4	75.5	228.6
0	371	91.6	24.3	67.4
1	390	100.0	25.6	74.4
2	309	139.2	35.6	103.6
3	265	150.9	41.5	109.4
4	198	141.4	20.2	121.2
5	177	175.1	45.2	129.9
6	118	110.1	16.9	93.2
7	84	107.1	11.9	95.2
8 and 9	96	114.6	52.1	62.5
10 and over	53	226.4	75.5	228.6
Total (a)	2,061	126.2	31.5	94.6

(a) Information was not obtained in two instances.

Table IV shows that the infant mortality rate varies in direct ratio with the number of the mother's previous pregnancies. Thus, among the infants born to the mothers with less than five previous pregnancies, 120 died in every 1,000

*This classification of the mothers differs primarily from that used in the preceding table quoted from the report of the New York Free Out-door Maternity Clinic in that it is based on the number of the mother's previous pregnancies including stillbirths instead of upon the number of living births excluding stillbirths and, secondarily, in that, as previous pregnancies are dealt with, the one resulting in the birth of the infant under consideration is not counted. It was adopted largely because of the difficulty of distinguishing deaths soon after birth from stillbirths.

births, in comparison with 135 among those whose mothers had had from five to ten previous pregnancies, and 226 among those who had had ten or more.* The rate of mortality from the diseases of early infancy and congenital malformation combined and from all other causes varied in the same manner, thus showing that the influence of the number of the mother's previous pregnancies on infant mortality is both prenatal and postnatal.† There are, then, two distinct factors to consider in accounting for this relationship, first, the size of the family, and second, fertility and the effect of childbearing on the health and strength of the mother and her ability to bear strong and healthy children.

*Closer examination of the lower part of the table where each pregnancy group is considered separately shows that the relationship is not entirely continuous. Thus, although the rate increases in almost continuous succession with the number of the mother's previous pregnancies up to the sixth group, it then begins to decrease and continues to do so until the group of mothers having eight and nine previous pregnancies is reached when it begins to rise again, until in the last group the highest rate of all appears. (The rate for the last group when subdivided was 171 for the infants born to those mothers having 10 or 11 previous pregnancies and 333.3 for those having 12 or more.) Practically the same condition is also seen to exist when the previous table compiled from the figures of the New York Free Out-door Maternity Clinic is examined in a similar manner.

Yet, these exceptions do not disprove, as might appear at first sight, the tendency shown when the pregnancy groups were combined. The drop in the mortality rate for the infants born to the mothers who had already had six or seven previous pregnancies is probably due to the fact that a large number of previous pregnancies not only decreases the chances of life of the infants born but, in the case of the weaker mothers, also tends to make childbearing impossible or else so perilous that it is voluntarily refrained from. It is, therefore, to be expected that the proportion of infant deaths to births will begin to decrease after the fourth and fifth pregnancy group when the weaker mothers begin to drop out of the ranks of the childbearing, thus leaving in these groups a larger proportion of strong and healthy mothers whose children will be relatively better fitted to survive.

That the low mortality rate for infants in the sixth and seventh group is due to the inclusion of a larger proportion of strong and healthy mothers in them is shown by an examination of the last two columns of the table where it will be seen that the drop in the rate from the diseases of early infancy and congenital malformations—diseases largely due to the condition of the mother during and before pregnancy—is greater than that from all other causes of death, these being largely the result of conditions arising after birth and not so directly connected with the intra-uterine period of the child's development. But even though from the standpoint of childbearing the physical condition of the mothers in the sixth and seventh groups may be so good that it renders their children relatively immune from the effects of continuous childbearing, in time, if they continue, their children will also be affected, as is shown by the renewed rise in the rate for the groups following the seventh.

These exceptions, therefore, cannot be regarded as vitiating the tendencies shown when the pregnancy groups are combined or as materially weakening the conclusion that the rate of infant mortality varies strikingly with the number of the mother's previous pregnancies and the number of children to which she has previously given birth.

†This follows from the fact—a fact that space does not permit us to submit detailed proof of—that the deaths of infants during the first week and month of life and to a lesser extent during the first three months are largely the result of conditions which affected the child's organism before birth and while it was developing in the mother's womb, or in other words largely the result of prenatal conditions, while the deaths of the later months of infancy are largely the result of conditions which affected the child after its birth, or in other words to the influence of postnatal conditions.

In accounting for this relationship between the size of the family and infant mortality several considerations should be borne in mind. It is to be expected, for instance, that congestion both as shown by the average number of persons per room and the number of persons sleeping in the bedroom with the infant will be greater among large than small families, and this was found to be true in the Boston inquiry.* Poverty, too, is generally agreed to be worse, other things being equal, where the number of small children in the family is large.† Moreover, those parents who bring into the world larger families than their neighbors deem themselves able to rear properly are frequently improvident, with a low standard of life, and in addition, are often characterized by a lack of intelligence or of sufficient knowledge of the simpler laws of hygiene. This is, of course, not true of the parents of all large families but of a sufficient number of them to raise the mortality rate for the class. In the Boston investigation it was found that of 341 mothers of whose character and intelligence the investigators felt competent to express an opinion,

*PER CENT. OF INFANTS VISITED IN THE BOSTON INVESTIGATION, CLASSIFIED ACCORDING TO THE NUMBER OF THEIR MOTHERS' PREGNANCIES WHO LIVED IN HOUSEHOLDS WHERE THE AVERAGE NUMBER OF PERSONS PER ROOM WAS LESS THAN TWO, TWO, OR THREE OR MORE.

Number Mother's Pregnancies.	Less than Two.	Two.	Three or More.	Total.	
				Per Cent.	Number.
1	84.6	14.0	1.4	100.0	349
2, 3 or 4	59.5	35.1	5.4	100.0	908
5 or 6	34.2	44.9	20.9	100.0	350
7 or 8	18.7	61.0	20.3	100.0	192
9 or more	17.7	61.7	20.6	100.0	141
Total	52.3	37.6	10.1	100.0	1,940

†Bertillon in the following figures has shown this relationship of poverty to the size of the family in Paris (Nombre D'Enfants par Familles, Journ, de la Soc. de Statisque de Paris, April, 1901, p. 134. Quoted in Bailey's "Modern Social Conditions," p. 111), in the following table showing the number of children per 100 families in Paris, classified according to the economic resources of their parents (1896):

Very poor	156
Poor	144
Comfortable	131
Very comfortable	129
Rich	129
Very rich	127
Entire city	140

a somewhat larger proportion of the mothers of large families were rated as unsatisfactory in these respects than of those with small families.* The mothers of the larger families also ranked lowest when graded according to their knowledge, or rather their observance, of the laws of hygiene, this being especially evident when they were graded according to their standards of cleanliness and of ventilation.†

But all this leaves unanswered the question whether, other things being equal, the number of children in the family into which the infant is born has any direct postnatal influence upon the mortality rate. Doctor Newsholme, an eminent English authority, feels that it does not. He says, though he gives no data to sustain his opinion, that "large families evidently do not necessarily imply a tendency to high infant mortality. The connection often observed between a high birth rate and a high rate of infant mortality probably is due in great part to the fact that large families are common among the poorest classes, and these classes are specially exposed to the degrading influences producing excessive infant mortality."‡ This view, however, seems very onesided. While it is undoubtedly true, as has already been shown, that "the de-

*These figures were as follows:

Of 341 mothers of whom an opinion was given 81 were unfavorable; classifying these according to the number of the mother's pregnancies (including the one resulting in the birth of the infant under consideration) they were found to include:

8 per cent. of those who had had 1 pregnancy,

29 per cent. of those who had had 2, 3, or 4 pregnancies,

30 per cent. of those who had had 5 or more pregnancies.

†Thus, 781 out of 1,817 mothers from whom information was obtained said that they did not ventilate their bedrooms at all at night.

These included:

40 per cent. of those who had had 1 pregnancy,

44 per cent. of those who had had 2, 3, or 4 pregnancies,

46 per cent. of those who had had 5, 6, 7, or 8 pregnancies, and

32 per cent. of those who had had 9 or more pregnancies.

Thus, with one exception the per cent. of mothers who said that they did not ventilate their bedrooms at night increased with the number of the mother's pregnancies. This exception, which occurs with the mothers who had 9 or more pregnancies, may be due to chance, as the group included only forty cases.

Dr. Herman Schwarz in the First Annual Report of the Free Out-door Maternity Clinic (New York, 1910), p. 41, gives similar figures verifying the statement that the mothers of the larger families rank lower in general intelligence and in knowledge of hygiene than those of smaller families.

Thus, out of 679 mothers, 67 were graded as unsatisfactory in intelligence and 612 as satisfactory, the average number of children born per family being 3.8 among the former and 3.1 among the latter.

Of 670 mothers 491 were graded as having an unsatisfactory and 179 as having a satisfactory knowledge of infant hygiene, the average number of living births per family being 3.9 among the former and 3.5 among the latter.

‡Great Britain, Local Government Board, Supplement to the Thirty-ninth Annual Report, p. 49.

grading influences producing excessive infant mortality" also tend to produce excessively large families—or else both the degrading conditions and the excessively large family are produced by the same deeper-lying causes—it is also just as true that an excessive number of children in the family in itself brings about conditions in the home that lower the infant's chances of survival. The term "large family" is, of course, relative. In some cases, where the parents have sufficient resources, interest, and leisure from other duties, what might otherwise be regarded as an excessively large family would under such circumstances be regarded only as normally large. On the other hand, it is difficult to understand how, in cases where the parents have not the resources, the interest, or the ability to provide for more than three children properly, the chances of survival of subsequent infants born into the family will not be lessened, other things being equal, by the birth of more than this number of children.

It is not difficult to understand how the popular misconception that the death rate in large families is low has arisen. The large families we meet so impress us with the number of children who are living that we forget the number who have died while, again, we never notice the small families that would have been large if so many of the children had not died during infancy and childhood. The writer has been unable to find any evidence whatever to support this popular belief that large families have low infant mortality rates, while there is abundance of evidence to show that the rate of infant mortality increases with the size of the family, and no small amount of evidence to show that the mortality rate for children and even adults is greater in large families than in small.*

The Influence of the Length of the Interval Between the Mother's Pregnancies.—As has already been intimated, the influence—both prenatal and postnatal—of fertility and the size of the family on infant mortality is partly determined by the length of the interval between the mother's pregnancies or deliveries.

*See especially the article by March in the Journal of the Royal Statistical Society, Vol. LXXV, pp. 519 ff., previously quoted, and Dr. R. J. Ewart's two articles in the Eugenics Review on "The Aristocracy of Infancy and the Conditions of Birth," Vol. III, pp. 142–70, and "The Influence of Parental Age on Offspring," Vol. III, pp. 201–232. In the latter of these articles Doctor Ewart shows how the mean height of children is also affected adversely by the order of birth (p. 213).

Where this interval is large the influence of large families is less but where it is small it is much greater. The relation between the average interval between the pregnancies of the mothers visited in the Boston investigation and the rate of infant mortality is shown in the following table:

TABLE V.

MORTALITY RATE PER 1,000 BIRTHS FOR INFANTS BORN TO MOTHERS VISITED IN THE HOUSE-TO-HOUSE INVESTIGATION IN BOSTON, CLASSIFIED ACCORDING TO THE AVERAGE INTERVAL BETWEEN PREGNANCIES.

Average Interval between Mother's Pregnancies.	Number of Births.	Infant Mortality Rate.
1 year or less	159	138.4
1½ years	197	147.2
2 years	641	127.9
3 years	458	128.8
4 years	113	106.2
5 years and over	67	185.0
Total	1,635 (a)	132.1

(a) Information was not obtained in 57 instances. The 371 infants who were born during their mothers' first pregnancies are not included in this table.

Table V may at first sight seem to show no relationship between the average interval between the mother's pregnancies and the rate of infant mortality. Thus, although the rate decreases as the length of the interval increases until the period of five years and over is reached (from 143 where the average interval was less than two years to 128, 129 and 106 where it was two, three, and four years respectively) it then increases to 185 deaths per 1,000 births with the group of mothers the average interval between whose pregnancies was five years and over. Moreover, although the mortality rate for the first two groups combined (one year and less and one and one half years) is greater than that for the next three the rate for the first group proves to be higher than that for the second when they are separated (138 and 147 respectively). Yet, closer examination of the results shows that these apparent exceptions are not of sufficient importance to influence the conclusion.

In the former case, the rise in the mortality rate with the group where the interval between pregnancies was five years or over can be accounted for in two ways; first, on the supposition that the number of cases included in the group is too

small (67) to allow any weight to be given it in drawing conclusions, or, second, on the supposition that such an exceptionally large interval between pregnancies as five years or more is, among families of the class for the most part visited in this investigation, generally the result, not of choice but of weakness or physical incapacity—a condition which would be likely to effect the strength and resistance of such children as might be born and thereby to raise the mortality rate for the class.

In the latter case, the fact that the rate for the group of infants born to mothers with an interval between pregnancies of one year or under is less than that for those where the interval was one and one half years does not disprove the existence of a relationship between the infant mortality rate and the length of the average interval between the mother's pregnancies because the rate for the first group where the average interval was less than one year would have been much higher if it were not composed so exclusively of mothers who had had few previous pregnancies and whose families were, therefore, small—a class which, as has already been shown, tends to have a very low infant death rate. In fact 70 per cent. of the mothers in this group had had only one previous pregnancy.

To fully appreciate the influence of this small interval between pregnancies the mothers in the group must be further classified according to the number of their previous pregnancies. When this is done it will be seen that the mortality rate for the infants born to mothers in the group who had had 1, 2, or 3 previous pregnancies was 129; for those who had had 4, 5, or 6 it was 333; while for those who had had over 6 previous pregnancies it reached the enormous proportion of 500 deaths per 1,000 births. A careful examination of the table, therefore, indicates, when account is taken of the number of the previous pregnancies and the size of the families of the mothers included in each group, that there is a striking relationship between the rate of infant mortality and the average interval between the mother's pregnancies.

Doctor Ewart in a recent article in the *Eugenics Review* emphasized this need for the "adequate spacing of births" by showing that the physical development of the children who

survive is retarded by a short interval between births. Thus, as he shows in the following table, the average height and weight of over 800 children at the end of the sixth year of age was greater where the interval between births was large than where it was small:

TABLE VI.

RELATIONSHIP BETWEEN THE LENGTH OF THE INTERVAL BETWEEN BIRTHS AND THE MEAN HEIGHT AND WEIGHT AT THE END OF THE SIXTH YEAR OF AGE AMONG 866 CHILDREN OF MIDDLESBOROUGH, ENGLAND; 1911. (a)

Interval Between Births.	Mean Height in Inches.	Mean Weight in Pounds.
Less than 2 years	38.6	37.2
2 and under 2½ years	39.9	38.8
2½ to 3 years	40.3	39.1
3 years and over	41.7	39.4

(a) R. J. Ewart, M.D., "The Influence of Parental Age on Offspring," Eugenics Review, Vol. III, p. 211.

In commenting on this table Doctor Ewart says: "The female is used to the greatest extent that her fertility will allow; births at intervals of eleven months being quite common. . . . The birth interval is so short that the mother is unable to bring her whole vitality to bear. Thus one child, as it were, spoils the next." He then asks this very pertinent question: "Which is the most desirable, three children of a mean height of 39.5 inches or two of 41.0 inches, with all the other attributes of mankind altered in the same proportion? . . . As regards the individual there is no hesitancy as to the answer; but from the point of view of economic production it is quite possible that three inefficients may be better and do more work than the two efficients. Racial supremacy, however, is not a question of numbers, and concerns individual fitness only."

It must not be forgotten, moreover, that the mothers themselves do not escape without injury from the strain put upon them by too frequent childbearing; but this lowering of the vitality and strength of the mother as a result of an insufficiency of time between the two pregnancies for complete recovery from the strain of the first creates a condition which will be likely, other things being equal, to harmfully affect both the prenatal and postnatal development of subsequent

children. In fact, both the mother and the children suffer when the length of the interval between births is too small. It is manifestly impossible for most mothers to properly nourish themselves, a new born baby, and a child within the uterus at the same time.

This point is especially important, for artificial feeding is more often resorted to by these mothers who are attempting to rear two babies at once—one within the womb and the other just born. Among the mothers visited in the Boston enquiry, for instance, 25 per cent. said that they had resorted to the use of bottle feeding because the quantity or the quality of their breast milk was reduced by a subsequent pregnancy. Among the Italian mothers this reason was given in over half the cases—a truly astounding proportion. Thus, when it is remembered that bottle feeding decreases the chances of survival of the baby from three to five times (as all authorities agree),* it can readily be understood how the coming of one child spoils the chances of survival of the previous one.

It is thus apparent that the influence of fertility and the size of the family, especially when combined with the influence of the length of the interval between pregnancies, constitutes an important factor in infant mortality. As Doctor Ewart says: "The wastage of life, and production of immature progeny with its consequent misery and suffering to the mother, can, to a much larger extent than is generally believed, be traced directly to the unfortunate fact that the fertility of women between their twenty-fifth and thirty-fifth years exceeds their power to reproduce healthy offspring." † However dangerous "race suicide" and the declining birth rate may be there can be little doubt that excessively large families is no remedy, and however desirable a high rate of births may be it is mere waste to bring children into the world faster than the laws of nature decree to be desirable.

*See, for instance, the report of the investigation by the Children's Bureau of Infant Mortality; Johnstown, Pa., pp. 38-4, Davis' "Statistical Comparison of the Mortality of Breast-fed and Bottle-fed Babies" in the Am. Journ. of Diseases of Children, March, 1913, pp. 234-47, and the U S. Bureau of Labor's Investigation of Infant Mortality in Fall River, Mass.

†Prev. cit., p. 215.

MEASURE OF RURAL MIGRATION AND OTHER FACTORS OF URBAN INCREASE IN THE UNITED STATES.

By John M. Gillette and George R. Davies.

Among those who discuss urban and rural matters the usual assumption relative to urban increase of population is that city growth is almost wholly due to the migration of people from the country and that the so-called rural depopulation is due to the same cause. One of the writers has made several attempts to estimate the force of the factors of urban increase, although those estimates must now be regarded as inconclusive and incorrect.* Practically no one else seems to have been interested in the publication of estimates of city gains. But recently Professor F. Stuart Chapin has published an article entitled "Immigration as a Source of Urban Increase."† It is believed that the present article contains fairly complete and accurate estimates touching several points related to urban increase.

In revising his Constructive Rural Sociology, one of the present writers again took up the work of estimating the force of the various factors contributing to urban population increase. It was his good fortune to hit upon a method of treating the subject which takes the calculations out of the realm of guess-work. The present article embodies the chief features of the method and gives the various results, some of the most important of which are by-products of the end aimed at. An application has been made of the method to each of the nine geographical divisions of the nation and a rate of natural increase of population has been attained, in spite of the fact that we are lacking birth registration and that death registra-

*See articles by John M. Gillette, "City Trend of City Population and Leadership," Quarterly Journal, University of North Dakota, October, 1910; "The Drift to the City in Relation to the Rural Problem," American Journal Sociology, Vol. 16, p. 645; "Constructive Rural Sociology, Chapter, Rural and Urban Increase."

†Quarterly Publications, American Statistical Association, September, 1914.

tion is partial for the nation. It is the aim to publish this part of the work at some later date.

After the writer alluded to above had blocked out the method employed in the rough he was joined in the work by his colleague, Dr. George R. Davies, who contributed many suggestions toward purifying the method and giving it greater accuracy. That part of this paper which deals with the application of the method to the various classes of cities of the nation is entirely his work.

This paper claims to attain four results relative to the decade, 1900–1910, none of which, save perhaps the first one enumerated, have previously been worked out. 1. The establishment of a rate of natural increase for the national population. 2. The establishment of the birth rate, and the rate of natural increase for both the rural and urban groups of the nation. 3. The establishment of the force of each of the factors contributing to urban increase of population. 4. The establishment of the same for the various classes of cities.

Natural Increase in the United States.—Before we are able to determine the force of the various factors which produce the increase in urban population it is necessary to discover the rate of natural increase for the nation as a whole. The rate of increase of the total population between 1900 and 1910 was 21 per cent. But it is obvious that the natural increase rate must be much less than this since the nation has received millions of persons from abroad and sent out hundreds of thousands of emigrants during that interval. Hence to determine the natural increase rate it is necessary to consider the factors of immigration and emigration.

There are two methods of discovering the force of immigration in determining the rate of natural increase for the United States. One method is to use the net immigration worked out by the last Census (Thirteenth Census, *Abstract*, p. 191). The other is to use the foreign born population living in 1900 and 1910 as a basis to discover the amount of the new decennial immigration. The latter method is employed here because it is the one used in the subsequent operations of obtaining the natural increase for the various geographical divisions and the force of the factors of urban increase. The

results obtained by the two methods differ so slightly as to be inconsequential.

The foreign born population of the nation in 1900 was 10,341,-276. Reducing this amount 20 per cent. to allow for deaths during the decade (Figured from statement of Census, 1910, Vol. I, p. 1017) the number living in 1910 is 8,273,000. The number of foreign born according to the Census of 1910 was 13,515,886. Subtracting those of 1900 who were living in 1910 from the number given in 1910, the difference, 5,242,286, represents the new immigrants. To get the full force of immigration on increasing the national population during the decade this amount must be increased by 17.4 per cent., a percentage now to be explained.

To the 5,242,000 new immigrants should be added their children which were born in the United States. The birth rate for the immigrant group was estimated at 38.96 per thousand annually. This conclusion was reached by taking the average birth rate of all the countries from which the larger number of the immigrants come. This was found to be 31.5. This rate should be increased 68.5 per cent. because of the fact that immigrants are predominantly adults.* A decrease in the resulting rate of 77.3 per cent. must be made to allow for the fact that a large number of the immigrants leave their wives in the home country.† Allowing next for the death rate among the children of the immigrants, the net result of 17.4 per cent. increase is obtained, amounting to 912,000. This gives the total force of new immigration during the decade of 6,154,000.

Emigration must also be considered. It is strange that there are no reliable statistics for the total amount of emigration of the citizens of the United States to foreign countries. Yet the amount must be considerable, as it is well known that a large number of farmers and laborers have gone to Western Canada, and there has been in addition some exodus to the Philippines, Mexico, Cuba and Porto Rico, South America, and other regions. Fortunately, however, a failure to esti-

*Comparison of probability curve, based on figures in Statistical Abstract, U. S., 1913, p. 86, with the normal age distribution of population.

†Jenks and Lauck, "The Immigration Problem" (p. 466).

mate closely this item is not at all serious since it has little or no effect on the principal result sought—namely, the migration from rural to urban districts—except in so far as the emigration is proportionately greater from one district than from the other. The reason for this is that the estimate of the emigration affects the computation of the natural increase, and it will be seen that the two items offset each other when it comes to finding the balance accounted for by migration from country to city. And in so far as this emigration is in excess of the normal ratio from the rural districts it can be stated with some approach to accuracy.

A safe estimate for the total emigration during the decade would be 550,000, of which 192,500 may be assigned to emigration from cities.* Add to this the natural increase of the emigrants for the average of five years that the group would be out of the country—anticipating the rate of 13.7 per cent.—and we have the item of 588,000 as the total loss by emigration from the United States as a whole during the decade under consideration.

Bringing together the results thus far obtained it can be stated that the balance of immigration over emigration accounts for an increase by 1910 as compared to 1900 of 5,566,000 for the country as a whole.

In the light of the preceding deductions, it becomes an easy matter to compute the natural increase of the population of the United States during the decade. The total increase as shown by the Census was 15,977,691. Deducting from this the number accounted for by the excess of immigration over emigration as just stated, there remains a balance of 10,411,000—taking the nearest hundreds.

Comparing this number—which of course must represent the natural increase of the national population—with the population of almost 76,000,000 in 1900, there is found to be an increase of 13.7 per cent. for the decade.

The substantial accuracy of this rate is vouched for by employing another method to arrive at the natural increase of population. This is based on an estimate of the birth rate of the national population and the use of the mortality rate

*Immigration Facts and Figures, 1911, Dept. of Interior, Ottawa, Canada, p. 20.

given by the government mortality reports. The number of children under 5 years in urban communities in 1910 was 4,200,000 in round numbers. This represents 86 per cent. of those born. This rate is obtained by taking the average death rate from a probability curve made from the data contained in recently published life tables (American Life Tables, C. H. Forsyth, Amer. Stat. Association, Sept., 1914, p. 234). The entire number of children born was 4,880,000. Dividing this number by the estimated urban population midway between 1907 and 1908, to get the average age of the children of the five year age group, the birth rate per year of 2.47 is obtained, which converted into a decennial rate becomes 24.7. Treating the rural five year age group and the correlative population in the same manner a rural birth rate of 30.36 for the decade is obtained.

The average mortality rate for urban districts of the registration area is found to be 15.9; that for rural districts, 13.4. Subtracting these rates from the appropriate birth rates we get a natural increase rate for urban districts of 8.8 and a rural rate of 16.96. Employing the method of weighted average we obtain the natural increase rate for the whole nation of 13.68, or practically the previous rate of 13.7.

Relative Force of the Factors Contributing to Urban Increase. —The factors which account for urban increase in the United States are immigration and emigration, incorporation, natural increase, and migration from rural districts. A treatment of each of these factors will indicate their relative force in urban gains.

1. It is a simple matter to demonstrate that alien immigrants are settling dominantly in a few states and in the cities. Thus in 1909, 6 states, Massachusetts, New York, New Jersey, Pennsylvania, Ohio, and Illinois, received 529,688 aliens and lost 152,178, retaining 71.3 per cent. In that year those states contained 71.1 per cent. of all immigrant aliens of the nation. During the period 1908–1913 those states, together with California, Connecticut, and Michigan received 70 per cent. of the net immigration of the country. The 6 states first mentioned also sustained 49.2 per cent. of the national urban increase. The 9 states above mentioned, together

with Wisconsin, Minnesota, Texas, and Washington, accounted for 71.1 per cent. of the urban gain of the nation. By a comparison of urban growth and immigration it is evident that the immigration to the 6 states and the 13 states named above almost equals their urban increase. That to the whole nation is equal to 74.5 per cent. of its urban increment. There is thus reason for thinking that immigration to the United States outside of the above states has less to do with populating cities that it does within those states.

We have not thus far demonstrated in exact statistical terms what portion of the immigrants which go to the different states settle in cities. The facts just presented create a strong presumption that the immigrants largely locate in cities. This presumption becomes all the stronger when we consider the industrial situation. Relative to that of the 6 states considered above, is there any reason to think that any large portion of their immigrant aliens go into agriculture? All of those states have had their available agricultural land occupied for a long time, and while land changes owners to a limited extent the scope of the exchange is too limited to absorb many of the immigrants. Nor is there evidence that immigrants to any considerable extent are purchasers of land in those states. And what is true of the 6 states obtains in Connecticut and is only a little less true of the 7 additional states which constitute the 13.

Therefore, since the states alluded to manifest nearly three fourths of the urban increase of the nation, since they absorb almost as great a proportion of the immigration, since the amount of their immigration equals so much of their urban gain, and since the logic of their industrial conditions is against the absorption of their immigrants by agriculture, the conclusion must be that their immigrants largely settle in their cities and in a large measure cause their growth.

Having established the probability that immigrants predominantly settle in cities it is necessary to bridge the gap and show to what extent they actually do so and what proportion of urban increase they account for. A previous statement exhibited the decennial increase of the population of the nation

which was due to the immigration of the decade, together with its natural increase.

What portion of this immigration which arrived during the decade 1900–1910 goes to the cities may be determined as follows. There were in 1910, 13,515,886 foreign born in the United States, of whom 72.2 per cent., or 9,770,000 were living in urban districts. (Thirteenth Census, Vol. I, pp. 139 and 189). In 1900 the number of foreign born in urban districts, similarly computed, was 6,910,000. In order, however, that precisely the same territory may be compared there should be added to the latter the foreign population of rural territory that becomes urban by 1910. The total population of this territory, was 813,000 in 1900 (Table 37, Vol 1, p. 60, Thirteenth Census). This territory being at the line between urban and rural may be taken as having about the same percentage of foreign population as the United States taken as a whole, or 13.6 per cent. This percentage, 111,000 added to the former total, gives 7,015,000 as the total foreign born population in 1900 living in territory urban at the close of the decade. Of this number 80 per cent. would be living in the United States at the close of the decade, or 5,612,000 (Thirteenth Census, *Abstract*, p. 191). The difference between this number and the number of foreign born enumerated in 1910 would of course represent the net result of the immigration to the cities during the decade. The difference is 4,145,000, or 79 per cent. of the total immigration of the decade. With this may be taken the proportionate share of the offspring of the new immigrants as previously computed, or 721,000, making a total of 4,866,000 of the urban population in 1910 which is accounted for as the result of foreign immigration.

2. The contributive force of natural increase of urban populations in accounting for their gains is quickly estimated, since we were obliged to establish the urban natural increase rate in demonstrating the second method of obtaining the rate of natural increase of the nation. It was found to be 8.8 per cent. Applying this rate to the urban population of 1910 the resulting increase for the decade is found to be 2,715,000. From this amount must be deducted the number of emigrants having their origin in the cities who leave the United States

permanently. It was found that the emigrants together with their natural increase for the decade ending 1910 numbered 588,000. The due portion which came from urban districts amounted to 206,000, leaving 2,509,000 as the contribution the cities make to their own gain by natural increase.

3. It is evident that a certain part of the increase in urban population as given in the census is to be attributed to the fact that towns under 2,500 in 1900, which are then counted as rural territory, may pass the 2,500 mark during the decade and be included in the urban population in 1910. In a similar way a large city may grow and absorb the population of a suburb that in the early part of the decade was rural territory. The amount of population transferred bodily in these ways from one classification to the other has already been stated on the authority of the census as being approximately 813,000. To this must be added the natural increase of the same population, which at the rate of 13.7 per cent. already determined would amount to 111,000, making a total of 924,000 to be accounted for in this way. The foreign immigration to this territory during the decade has already been taken into account by considering the territory urban and including it in the computation for the results of immigration, as given.

4. There remains the computation of the amount of urban growth to be accounted for by migration from rural regions. The simplest way to arrive at this is to deduct from the total urban growth as shown in the census the various items now determined. These items, with the percentage that each is of the total gain, are as follows:

	Amount.	Per Cent. of Urban Increase.
Urban gain, as per census	11,826,000	
Accounted for by immigration	4,866,000	41
Accounted for by natural increase of population	2,509,000	21.6
Accounted for by incorporation of new territory with urban territory	924,000	7 6
Balance, migration from rural to urban districts	3,527,000	29.8

It will be seen that the same method that has been applied to the problem of urban increase might be applied to rural

increase. The result, of course, should be the same total migration to the cities that has just been determined. The computation has been made and the required result obtained, but it is not worth while to take the space for the computation in view of the fact that the one item in common is rural migration to cities and that has proven to be the same.

The question might be raised as to how much of the rural migration appearing above is from the open country, and how much is from the incorporated places under 2,500 classified as rural in the census. There appear to be no data from which this question may be answered with precision, but on the other hand there is no marked objection that can be urged against assuming that the migration from the open country was as least proportionate to its population. In fact it probably was more than proportionate, since, as it will be shown, the migration to the group of smaller cities is clearly marked and incorporated places under 2,500 would present conditions somewhat similar to those in cities in the class next above 2,500. The census shows that 83.5 per cent. of so-called rural population is actually in the open country (Thirteenth Census, Vol. I, p. 64). It is therefore safe to conclude that at least 2,950,000 out of the total 3,527,000 rural migration, represents the movement from the open country to the city.

Urban Increase by Classes of Cities.—It will be of interest to carry the analysis of the increase of urban population one step further and compute it for the various groups of cities as classified by size. The results of this analysis are given in the accompanying table. The methods used are the same as in the preceding study, except as will be explained. The principal difference in method is in handling the amount of population which changes its classification or is incorporated with the growing city during the decade. It would be difficult to compute just what this amount would be for each class of cities, since each class both loses and gains a certain amount during the decade. The computation is therefore based directly upon the population of territory as it was classified in 1910, carrying this classification back to 1900. The classification in this form is given in the census (Thirteenth Census, Vol. I, p. 71). By this method there is, of course, no gain by

change in classification or by incorporation to be considered. The gain by immigration is determined by the same method as before; that is, the foreign population in 1900 is decreased 20 per cent. for deaths and subtracted from the foreign population in 1910. The determination of the foreign population for the several groups of cities in 1900 is, however, somewhat difficult to reach, as the census does not analyze the 1900 population on the basis of the 1910 classification so as to show the foreign born population. The method used was as follows. A graph was drawn representing on the base line the population of the various groups of cities as then classified, in the order of the size of the cities. Vertically above the base line distances were measured to represent the percentage of foreign born white as given for each group of cities (*Ibid*, Vol. I, p. 184). The percentage of foreign born white was found to increase quite regularly with the increase in the size of cities, allowing the drawing of a fairly regular curve. The base line was then subdivided again on the basis of the classification of cities according to their grouping in 1910, and from the curve the percentages of foreign born white were read. These percentages were then applied and the number of foreign born white found for each group of cities. A slight increase (between 1 and 2 per cent.) was made to include the small number of foreign born colored. The offspring of these new immigrants during the decade was determined at the same ratio as previously found for the total new immigration, 17.4 per cent. The emigration was determined by distributing among the various groups in proportion to their total population the emigration from urban districts as previously estimated. The natural increase was also taken as before at 13.7 per cent. for the decade. The balance necessary to make up the total gain for each group of cities was taken, and regarded as the measure of rural migration to the cities. It will be seen, however, that in the case of the group of largest cities the balance is negative, indicating a loss of population to smaller cities or rural regions. This is very likely to be accounted for by the formation of the so-called satellite cities by the removal of large industries to less populous out-lying districts. The totals in the table when compared with the former summary

will be found to give slightly different results, due to the
in classification of the 1900 population.

There is throughout the calculations which have bee
in working out the method of treating the various fact
sidered in this paper a certain degree of error which is
the limitations of the slide rule. But as the errors ar
the cumulative kind, and as totals may be checked, t
error due to this source is almost negligible.

ANALYSIS OF INCREASE OF URBAN POPULATION, 1900-1910. CITIES CLASSIFIED ACCORDING TO THEIR POPULATION IN 1910.

	Cities having in 1910 a population of:					
	2,500 to 10,000.	10,000 to 25,000.	25,000 to 100,000.	100,000 to 500,000.	500,000 and over.	Totals.
Population, 1910	8,470,000	5,609,000	8,242,000	8,790,000	11,512,000	42,693,000
Population of same territory, 1900	6,195,000	4,153,000	5,977,000	6,354,000	8,931,000	31,610,000
Gain for decade	2,275,000	1,456,000	2,265,000	2,436,000	2,581,000	11,013,000
Gain by foreign immigrants and their offspring	622,000	476,000	865,000	910,000	1,993,000	4,866,000
Per cent. of gain	27.3	32.7	38.2	37.4	77.1	44.2
Loss by foreign immigration including offspring	−40,400	−27,100	−38,900	−41,500	−58,100	−206,000
Per cent. of loss	1.8	1.9	1.7	1.7	2.2	1.9
Gain by natural increase of population	543,000	365,000	527,000	560,000	787,000	2,782,000
Per cent. of gain	23.9	25.1	23.2	23	30.5	25.3
Balance, migration from rural regions, or other cities	1,150,000	642,700	911,900	10,075	−140,900 (a)	357,100
Per cent. of gain	50.6	44.1	40.3	41.3	5.4 (a)	32.4

(a) Loss.

CONTRIBUTIONS TO URBAN GROWTH.

By Earle Clark, *Russell Sage Foundation.*

The rapid growth of the population of American cities is a familiar and widely discussed statistical fact. In recent years the cities have contributed much more than their proportional share to the growth of the country's population. From 1900 to 1910 the population of urban communities increased by 35 per cent. while the population of rural territory increased by but 11 per cent. The increase in numbers in the total population for the decade was 15,977,691, and of this increase 11,013,738, or 69 per cent., was urban increase. *

There are three possible sources of urban growth—alien immigration, natural increase (the excess of births over deaths), and migration from rural to urban communities. What is the contribution made by each of these sources? Is alien immigration, as has been suggested, the preponderant source of city growth? †

It is perhaps natural that such a rôle should be imputed to alien immigration. Of all the factors which have their part in the growth of population, immigration is the only one which in the United States is systematically recorded. The figures roll up into the millions in each decade, while the even greater number of births and deaths is only partially registered. Hence immigration looms larger perhaps in the popular estimation than its importance really deserves.

Information as to the relative share of alien immigration and natural increase, and, in relation to cities, as to the influx from the rural regions may be defective, but that need not deter us from the examination of the relative importance of these three factors in determining the growth of cities. We may indeed tread the ground of estimate rather than of enumeration, but evidence may be gathered and sifted to establish a reasonable probability. It is the purpose of this article to make such an effort.

* Census of 1910, *Abstract*, p. 55.

† Chapin, F. Stuart, Ph.D., "Immigration as a Source of Urban Increase." Quarterly Publications of the American Statistical Association, September, 1914, p. 223.

Gillette, John M., "Drift to the City in Relation to the Rural Problem," American Journal of Sociology, Vol. 16, p. 645.

Most of the statistical data which are available for the purpose are found in the United States Census reports for 1890, 1900, and 1910, and in recent reports of the Census Bureau on Mortality Statistics. This study deals chiefly with the decade 1900–1910, but some facts will be presented for the preceding decade.

From 1900 to 1910 the urban population of the country, that is, the population of the places having, in 1910, 2,500 or more inhabitants, increased from 31,609,645 to 42,623,383—an advance of 11,013,738.* What were the sources of this increment?†

The growth of city populations is the result of the action and interaction of a number of factors, some of which tend to augment and others to reduce the number of inhabitants. The factors which add to population are births, the coming in of people from foreign countries, and, in the case of city populations, the coming in of people from rural territory. The factors which tend to reduce population are deaths, the removal of people to foreign countries, and, in the case of city populations, removals to rural territory. It will be convenient, for the purposes of this discussion, to distinguish between births and deaths, the natural gain or loss, on the one hand, and the movements of population into and out of a given territory on the other hand.

Natural increase or decrease is determined by the difference between the number of births in a given period and the number of deaths. If the population of a territory was 1,000 at the beginning of a decade and, there being no movement of people into or out of the territory, 50 deaths and 100 births occur during the decade, the population at the end of the decade is, clearly, 1,050. The natural increase, figured on the population at the beginning of the decade, is 5 per cent. In a case of this sort, some of the 50 deaths reported would have occurred among the 1,000 persons living in the territory at the beginning of the decade, and some among the 100 children born during the decade, but the effect on population would be the same as

* Census of 1910, Vol. I, p. 62.

† Throughout this study, the exact figures as shown in Census reports, and the exact results of computations have been presented in preference to the round numbers. This procedure has been followed for convenience in checking. It will be understood that all the figures are to be considered as, at best, approximations to the truth. In drawing conclusions from the statistics, ample allowance has been made for the presence of this factor.

though all of the 50 deaths had occurred among persons alive at the beginning of the decade. It seems clear, on the other hand, that, where immigration occurs, deaths of persons who come in after the beginning of the decade and die in the territory before the end of the decade should not be considered in determining natural increase—that such deaths should be taken into account in fixing the gain from alien immigration. This is the procedure that has been followed in preparing the present study.

It can not be too strongly emphasized that the factor of natural increase applies to the whole population at the beginning of the decade, irrespective of its origin.

The number of the people in any region is affected not only by births and deaths, but by the passing of people from territory to territory. There is a movement into American cities from the country districts and a reverse movement from the cities into the country. Any excess of the inward over the outward movement represents an increase of urban population.

Still another factor affecting population is the movement of people from foreign countries into the cities and from the cities into foreign countries. This movement includes two distinct elements. The first element consists of natives of the United States who, in a given decade, remove from American cities to foreign countries or, having been abroad at the beginning of the decade, return to cities during the decade. It is clear that persons of this class going out tend to reduce and that persons coming in tend to augment urban population. Little or no statistical information is available as to the volume of this movement to and from American cities. The incoming and outgoing movements tend to balance each other and there is reason to believe that the balance is of slight relative importance.

The other element in the movement of population between American cities and foreign countries is contributed by persons of foreign birth. Of the foreign born persons residing in American cities at the beginning of a decade, a considerable number remove during the decade to foreign countries. On the other hand, in each decade a number of persons of foreign birth enter the United States from abroad and at the end of the decade are living in urban communities.

It is evident that the foreign born persons coming to the United States in any given decade, who settle in cities and are alive and in cities at the end of the decade, add to urban population, while foreign born persons who, having been in the country and in city populations at the beginning of a decade, depart to foreign countries before the end of the decade reduce urban population. The excess of persons coming in and remaining at the end of the period over persons going out, if there be an excess, represents the increase in urban population due to the immigration of the foreign born.

Alien Immigration.—What part of the urban increase from 1900 to 1910 was due to alien immigration? It is clear that the effect on population of the coming in of aliens is both direct and indirect. The direct effect is the gain due to the arrival of persons born abroad. The indirect effect is the gain due to the births of children of immigrants and of their children's children. All but a very small portion of the native born population of the United States is an indirect effect of immigration which has occurred during the last three centuries.

In undertaking a statistical study of the sources of urban increase it is necessary to keep within the limits set by the character of the evidence. As to persons actually born abroad, the statistical evidence is fairly complete; as to their children, it is much less complete. Children of the third and fourth generation are, for statistical purposes, indistinguishable from the rest of the native born population. In this article only the direct effect of immigration—the increase in population due to the coming in and survival of persons born abroad—will be considered.

The gain in the population of a given territory in a decade through alien immigration is a composite result. The first element is the whole number of foreigners who entered the territory during the decade, less those who left the territory and those who died during the period. This is the addition to the population made by alien immigration. But the increase by such immigration consists of such addition, less a deduction for those foreigners who were in the territory at the outset of the decade who during the period left the territory. The distinction between the addition to population through alien

immigration, and the net increase of the population through such immigration is an important one for the inquiry which is here undertaken.

What we have called the addition to the population through alien immigration, namely, the foreigners who having arrived in a given territory during the decade were found living in it at the end of the period, is the exact equivalent of the number of persons of foreign birth in the territory at the end of the decade who had been in the country 10 years or less. Information as to the number of residents of urban communities who, in 1910, had been in the United States 10 years or less, is supplied by Census reports.

Of the 9,745,697 foreign born persons living in urban communities on April 15, 1910, 3,559,571 are reported as having arrived in this country after January 1, 1901. For 823,124 more the time of immigration is not reported. If it be assumed that the proportion of persons who immigrated after 1900 is the same for this latter group as for all persons the year of whose immigration is known, 39.9 per cent., the total number of foreign born persons surviving in 1910 who came to the United States subsequent to January 1, 1901, was 3,887,997.*

The Census of 1900 was taken as of June 1, and some foreign born persons found in cities in 1910 must have entered the country between June 1, 1900, and January 1, 1901. The number of these survivors is not exactly known, but may be estimated, either by reference to the number of survivors who entered the country from January 1, 1896, to January 1, 1901; or by reference to the number who came in from January 1, 1901, to January 1, 1906. If it be assumed that the number of foreigners living in American cities in 1910 who came to the United States in the 7 months from June 1, 1900, to January 1, 1901, stood to the number of those who came in the 60 months from January 1, 1896, to January 1, 1901, in the relation of 7 to 60, they must have numbered approximately 105,759.† In such a case the total number of foreign born residents

* Census of 1910, Vol. I, pp. 1021–2. Even if it were assumed that all of the 823,124 persons for whom year of immigration was not reported had arrived in this country within 10 years (and it is certain that all of them did not), the number of foreign born persons of less than 10 years' residence would be 4,382,695, a number which is 39.8 per cent. of the total urban increase.

†Census of 1910, Vol. I, pp. 1019–22. The number of persons found in cities in 1910 who arrived in the United States from January 1, 1896, to January 1, 1901, has itself been estimated by assuming that the ratio of urban residents of foreign birth to all residents of foreign birth was the same for persons who came in from 1896 to 1901 as for persons who came in from 1901 to 1906.

found in the cities in 1910 who had entered the country after the 1900 Census would have been 3,993,756. If, on the other hand, the number of foreign born residents of American cities in 1910 who entered the country in the 7 months from June 1, 1900, to January 1, 1901, be calculated in the ratio of 7 to 60 with reference to the foreign residents of 1910 who entered the country in the 60 months succeeding January 1, 1901, their number would be 202,517. In this case the total number of foreign born residents of 1910 who entered the country between the Census of 1900 and the Census of 1910 would have been 4,090,514. Neither of the estimates is more than approximately correct. Both fail to take account of the operation of the death rate which has presumably had a greater effect on the earlier immigrants than on the later, or of the general increase in the amount of annual immigration. Hence, the first assumption will result in an under-estimate and the second in an over-estimate. It is clear in any case that 4,090,514, the largest figure cited, the sum of a known figure and the maximum estimate, represents the maximum contribution to city populations made by alien immigration between the Census of 1900 and that of 1910.

The fact indicated by the foregoing figures is the contribution made by immigration to urban population, while the fact which we are seeking to establish is the contribution made by population to urban increase. As has been seen, contributions to population and contributions to increase are two very different things. Some foreign born persons living in American cities in 1900 left the country before the Census of 1910, and in attempting to determine the net increase due to immigration the number of these persons, if ascertainable, should be deducted from the number of foreign born persons found in cities in 1910 who had come to the United States within 10 years.

As the number of foreign born persons who emigrated from the United States, whether large or small, is to be deducted from the number of immigrants, it is evident that the figure cited above—4,090,514—represents, not only the maximum contribution of immigration to urban population, but the maximum contribution of immigration to urban increase. Is it possible to estimate closely immigration's minimum contribution to urban increase?

In order to ascertain the exact number of foreign born persons found in American cities in 1900, who emigrated from the country before 1910, it would be necessary to determine, not merely the number of persons who left the United States between 1900 and 1910, but the number departing in that period who were in the country in 1900, and were living in urban communities in 1900.

The reports of the United States Commissioner-General of Immigration show the total immigration to the United States for the years 1901–1913,* inclusive, and the number of aliens emigrating from the country for the years 1908–1913, inclusive. The emigrants are classified according to length of residence in the United States. If it be assumed that the ratio of departure to arrivals was the same for the years 1901–1907, inclusive, as for the years 1908–1913, inclusive, and that the distribution of the emigrants according to length of residence was the same for each year from 1901 to 1910, inclusive, as for the six-year period mentioned, then the approximate number of aliens in the United States in 1900 who left before 1910 was 782,423. This estimated number does not include those foreign born persons living in cities in 1900, and leaving the country before 1910, who were citizens of the United States at the time of their departure. It does include, however, aliens leaving the country between 1900 and 1910 who returned to the United States and to city populations again before 1910; and, what is more important, aliens who were living, in 1900, not in cities but in rural communities. It is believed that the inclusions outweigh the exclusions by a wide margin; hence that 782,423 represents the maximum number of foreign born persons found in urban communities in 1900 who left the country prior to 1910; and that, even when allowance is made for the fact that 4,090,514 is a maximum figure for the foreign born in urban communities in 1910 who came in after 1900, this number, less 782,423, that is, 3,308,091, represents the minimum contribution of immigration to urban increase.

As has been seen, the gain in urban population from 1900 to 1910 was 11,013,738. The maximum contribution of immi-

* The years to which the immigration statistics, referred to in this paragraph, relate are fiscal years ending June 30.

gration has been fixed at 4,090,514; the minimum has been estimated as 3,308,091. Hence the gain due to immigration does not exceed 37.1 per cent., and probably does not fall short of 30.0 per cent. of the total urban gain.

The facts regarding the contribution of immigration to urban population in the decade 1900–1910 may be compared, roughly, with facts for the preceding decade. The Census of 1900 does not show year of immigration of foreign born residents for all urban communities, but such information is available for cities which had, in 1900, 25,000 or more inhabitants. There were, in the 161 cities comprising this group, 1,323,234 persons of foreign birth who were reported as having been in the United States less than 10 years, and 380,543 foreign born persons for whom length of residence was not reported.* Assuming that the proportion of persons who had entered the country within 10 years was the same for the group last mentioned as for all persons the year of whose immigration was known, 27.8 per cent., the number of immigrants of less than 10 years' residence was 1,429,025. And as the population of cities having 25,000 or more inhabitants in 1900 increased in the decade 1890–1900 from 14,903,162 to 19,757,618, an increase of 4,854,456 persons,† immigration's contribution to population constituted but 29.4 per cent. of the total gain.

It should be remembered that the facts just given for the decade 1890–1900 relate to immigration's contribution to urban population rather than to urban increase. As available information concerning the volume of emigration is less complete for this decade than for the decade 1900–1910, it seems inadvisable to attempt an estimate of the gain in city population which is traceable to immigration.

Had immigration been the chief cause of urban increase in the 20 years from 1890 to 1910, there would have been, necessarily, an advance from census to census in the proportion of foreign born persons in the urban populations. The number of foreign born persons in urban populations is much less than half the total population, and hence any increase in the number of foreign born as great as or greater than the increase in

* Census of 1900, Vol. I, pp. 958–9.

† Census of 1900, Vol. I, p. lxxiii.

the number of native born would mean a considerable increase in the proportion of foreign born persons in the population.* The proportion of foreign born whites in communities of 2,500 or more inhabitants, classified by size, is shown by the following table for the dates 1890, 1900, and 1910:

FOREIGN BORN WHITES IN URBAN POPULATIONS. (a)

Groups of Communities.	Per Cent. of Foreign Born Whites in		
	1910.	1900.	1890.
All urban communities	22 6	22.2	24 8
Communities of from			
2,500 to 10,000 inhabitants	13.9	14 0	16 5
10,000 to 25,000 inhabitants	17.4	18.3	21.1
25,000 to 100,000 inhabitants	20.2	20.0	23.0
100,000 to 500,000 inhabitants	22.1	23.8	27.4
500,000 or more inhabitants	33.6	31.1	36.2

(a) Census of 1910, Vol. I, p. 173.

It will be noted that, for all urban communities and for each of the groups included in the table, the proportion of foreign born whites was lower in 1900 and in 1910 than in 1890. For the urban communities as a whole, and for two of the five groups of cities, the proportion of foreign born whites was slightly higher in 1910 than in 1900, but, as the native born persons in the population everywhere outnumber the foreign born, the figures do not mean, in any instance, that the numerical increase in the foreign born has been greater than the numerical increase in the native born.

Natural Increase.—The natural increase of population in American cities from 1900 to 1910 is not known from direct statistical evidence as in other countries, but can be approximately determined by estimate. A method for determining the natural increase of the population of the United States is indicated in the Census of 1910.† The natural increase for

* Thus, if to a population of 1,000 persons, of whom 750 were native born and 250 foreign born, there were added 100 native born and 100 foreign born, the proportion of foreign born would advance from 25 per cent. to 29 per cent. If, on the other hand, 100 native born persons and 100 foreign born were added to a population of 1,000 persons of whom 400 were native born and 600 foreign born the proportion of foreign born persons would fall from 60 per cent. to 58 per cent. Clearly, the effect of increments to different classes of the population on the proportion of these classes to total population depends, not only on the numerical size of each increment, but on the proportion which the class is of the total population.

† Census of 1910, *Abstract*, p. 78.

the country as a whole equals, approximately, the difference between the aggregate population of 1900 and that of 1910, less the number of foreign born whites enumerated in 1910 who had arrived in this country subsequent to 1900. The total population was 75,994,575 in 1900 and 91,972,266 in 1910, and the number of foreign born whites enumerated in 1910 who came to the United States after 1900 was 5,313,659.* Hence the increase not due to immigration was, approximately, the difference between 91,972,266 less 5,313,659 and 75,994,-575, or 10,664,032. The rate of natural increase, figured on the total population for 1900 was, accordingly, 14.0 per cent. What is the relation between this rate for the population as a whole and the rate of natural increase for urban population? Is natural increase more or less rapid in the cities than in the country as a whole, and how great is the difference?

In order to answer these questions it is necessary to consider deaths and births in the whole population and in city populations. While there are no mortality statistics for the whole population of the United States, death rates are available for the registration area and for registration cities having, in 1910, 10,000 or more inhabitants. The crude death rates for these areas should not be applied to the total population of the country and to the total urban population without making corrections for differences in the proportion of Negroes in the several population groups.† In all large populations the death rate for Negroes is much higher than the death rate for whites. Reasonably satisfactory results may be obtained by applying the death rates for colored persons‡ and whites,

* Census of 1910, Vol. I, pp. 1019–22. The figure presented is the sum of the reported number of foreign born persons enumerated in 1910 who came to the United States after January 1, 1901, and the estimated number of persons who came in from June 1, 1900, to January 1, 1901 The estimate was made by the method employed in determining the number of foreign born persons of less than 10 years' residence in the urban population and described above, p. 656. A maximum of 5,376,635 and a minimum of 5,250,683 were computed, and it was assumed that the actual number lies midway between these figures. The results obtained in the application of the estimate will not be appreciably affected by any error that may arise through this assumption.

† It would not be necessary to attempt to correct for differences in age distribution, even were it possible to do this, as there is no reason to believe that the relation between ages in the total population and ages in the total urban population differs greatly from the relation between ages in all registration territory and ages in registration cities.

‡ In the mortality statistics of the Bureau of the Census the returns for Negroes are not distinguished from the returns for the rest of the colored population. Negroes, of course, constitute a very large proportion of the total colored population.

respectively, in the registration populations, to corresponding groups in the whole population. In the total registration area the death rate for whites in 1910 was 14.6 per 1,000; that for the colored population was 24.2 per 1,000.* The number of whites in the total population of the United States in 1910 was 81,731,957 and the number of colored persons was 10,240,-309.† Hence, the number of deaths among the whites must have been approximately 1,193,287; and the number in the colored population, 247,815. The total number of deaths was, then, 1,441,102, and the crude death rate for the country's total population, 91,972,266, was, on this basis, 15.7 per 1,000.

In registration cities in 1910, the death rate was 15.5 for whites and 26.5 for the colored population.‡ As there were 39,831,913 whites and 2,791,470 colored persons in urban communities in 1910, § the deaths among whites numbered approximately 617,395 and the deaths among colored persons approximately, 73,974. Hence, the total number of deaths for urban populations was about 691,369, and the total urban population being 42,623,383, the death rate was 16.2 per 1,000. It will be assumed that 16.2 per 1,000 is the approximate death rate for all urban communities and that 15.7 is the death rate for the total population, both urban and rural, for the decade 1900–1910.

In the absence of trustworthy birth registration statistics the number of births occurring can be estimated by studying the proportion of native born children under five years of age in the population, and the death rates affecting young children.‖ In 1910 there were 10,483,695 native born children under five years of age in the total population of the United States, and 4,120,665 in the population of all urban com-

* Bureau of the Census, *Mortality Statistics*, 1910, p. 67.

† Census of 1910, *Abstract*, p. 77.

‡ Bureau of the Census, *Mortality Statistics*, 1910, p. 67.

§ Census of 1910, *Abstract*, p. 92.

‖ The migration of children under five years of age from country to city constitutes a possible source of error in estimates based on the statistics referred to. Among young children the amount of migration is, however, relatively small, and the movement from the country to the city must be balanced, at least in part, by a movement from city to country. It is probable that the influence of this factor is very slight indeed.

munities.* These figures do not represent the number of children born in the five-year period preceding the date of the Census, but the number born in such a period who survived to the end of the period. As the death rate among young children is everywhere high, the number of births must have exceeded considerably the number of survivors.† Is it possible to determine the approximate number of births for the country as a whole and for the cities?

In 1900 the death rate for children under five years of age in the entire registration area was 51.9 per 1,000, while that for the corresponding group in registration cities was 58.0 per 1,000. ‡ These 1900 rates are the most recent available for the whole registration area and for all registration cities, but rates are reported for 1911 for the entire population of the registration states and for the 50 cities having, in 1910, 100,000 or more population. Registration states may be regarded, for our purposes, as representative of the whole population. And as the 50 largest cities, while numbering a small fraction of the total number of registration cities, embrace a very large proportion of the total population of such cities, the rates reported may probably be regarded as representative city rates. In one respect the 1911 figures are superior to the 1900 figures—separate death rates are given for children under one and for children of from one to five years of age. The distinction is an important one, as mortality is always much greater in the first year of life than in the years immediately following. In 1911, for children under one year, the death rate in registration states was 112.9 per 1,000, and the average (unweighted) death rate for the 50 largest cities was 133.8 per 1,000; for children from one to five the death rate in registration states was 11.8 per 1,000, and the average (unweighted) death rate

* Census of 1910, Vol. I, p. 413. The figures given are, in fact, the returns for native born whites and for Negroes under the age of five years. Foreign born Negroes are included, while native born colored persons other than Negroes are not included, but as the number of persons under five years of age in either of these classes is very small, and as the inclusions and the exclusions tend to balance each other, the figures cited represent, with substantial accuracy, the numbers of native born children under five in the total population and in the urban population.

† The Bureau of the Census regards the birth returns as approximately correct only in those areas for which the reported number of births in a year exceeds the reported population under one year of age by 10 per cent. or more. Bureau of the Census, *Mortality Statistics*, 1911, p. 25.

‡ Bureau of the Census, *Mortality Statistics*, 1911, p. 16.

for the 50 cities was 14.6 per 1,000. * These rates corroborate the 1900 rates already cited—both sets of figures show higher mortality of young children for the cities than for the general population. The number of births which is followed by 1,000 survivors must therefore be greater in cities than in the country as a whole. "How much greater?" is the question.

If the 1911 rates cited are applied to the entire population of the country and to the entire urban population under five years of age for the years from 1905 to 1910, and if it be assumed that the death rates were the same at each age from one to five years, the number of births per 1,000 survivors under five years of age was 1,127 for the country as a whole, and 1,153 for urban communities.†

* Bureau of the Census, *Mortality Statistics*, 1911, p. 16.

† To derive the number of births from the known death rates the following method was adopted: If in the cities the death rate for children under one year of age was 133.8 per thousand, this means that there would be 133.8 deaths in a year in a group of children born on a given date whose number averaged, for the year following that date, 1,000. Assuming that the deaths were distributed evenly through the year, and hence that half occurred before the group was reduced to the average stated, the number of children at birth must have been 1,067, and the number of survivors at one year of age, 933.

If we knew the number of survivors exactly one year old in the populations with which we are dealing, we would need to go no further, for we could assume that the births were to the survivors one year old in the ratio of 1,067 to 933. But our only available figure for cities is the number of children under five years of age, while the best figure available for the country as a whole, the number of children under one year of age, represents a group whose average age cannot exceed and probably falls considerably short of six months, rather than a group of children exactly one year old. For these reasons, and as information as to the number of children under one year of age is, at best, uncertain, further computation is necessary.

The death rate in cities in 1911 for children from one to five years of age was 14.6 per thousand. If the 933 survivors at one year of age, determined in a preceding paragraph, were exposed, during the following year, to the death rate of 14.6 per thousand, the number of survivors at two years, determined by the process already demonstrated, would be 920. Continuing to apply the rate of 14.6 per 1,000 until the age of five years is reached, we obtain the following figures:

Year.	Death Rate.	Population at		
		Beginning of Year.	Middle of Year.	End of Year.
First	133.8	1,067	1,000	933
Second	14.6	933	926	920
Third	14.6	920	914	907
Fourth	14.6	907	901	894
Fifth	14.6	894	888	882

Further application of the method by which the foregoing table was derived shows that the number of survivors half a year from the beginning of the period would be 967; the number 1½ years from the beginning, 926; the number 2½ years from the beginning, 914; the number 3½ years from the beginning 901; and the number 4½ years from the beginning, 888.

In estimating the number of births in city populations, and in the whole population, it will be convenient to regard children under five years of age on April 15, 1910, as made up of five groups. One group consists

On this basis, as the number of children under five years in 1910 was 10,483,695 for the country as a whole, and 4,120,665 for urban communities, the number of births in the 5 years preceding was 11,815,124 for the entire country, and 4,751,126 for the cities; and the number of births per year was, approximately, 2,363,025 for the United States and 950,225 for the cities. The estimated population of the United States for the middle of the five-year period was 87,977,843; and the estimated population of the cities 39,869,949.* Hence the

of children who, having been born between April 15, 1905 and April 15, 1906, are from four to five years of age, their average age being approximately, four and one-half years. It is clear that the children of this group have been exposed to the death rate of children under one year of age for one year, and to the death rate of children under five years of age for 3½ years. Another group consists of children born between April 15, 1906, and April 15, 1907, who are from three to four years of age and whose average age is three and one-half years. The children of this group have been exposed to the death rate for children under o e year for one year, and to the death rate for children from one to five for 2½ years. The third, fourth, and fifth groups are made u› by the same method. Applying the principles discussed above to city populations in 1910 the essential facts and results for the five groups are as follows:

Group.	Children Born Between	Average Age, Apr. 15, 1910, in Years.	Years Exposed to Death Rate of. 133.8	Years Exposed to Death Rate of. 14.6	Births.	Survivors, Apr. 15, 1910.
1	Apr. 15, 1905, and Apr. 15, 1906	4.5	1.0	3.5	1,067	888
2	Apr. 15, 1906, and Apr. 15, 1907	3.5	1.0	2.5	1,067	901
3	Apr. 15, 1907, and Apr. 15, 1908	2.5	1.0	1.5	1,067	914
4	Apr. 15, 1908, and Apr. 15, 1909	1.5	1.0	.5	1,067	926
5	Apr. 15, 1909, and Apr. 15, 1910	.5	.5	..	1,033	967
Total					5,301	4,596

In other words, 5,301 births during a period of five years resulted in 4,596 survivors at the end of the period, or every 1,000 survivors represent 1,153 births. A similar mode of calculation is followed for the country as a whole with the result given in the text.

For these calculations we are far from claiming any absolute accuracy. They are designed to establish some relationship between the country as a whole and city population as respects the frequency of births. The assumption that the death rate for children from one to five applies at all ages within these limits is only approximately correct, as mortality is everywhere greater in the second year of life than in the years that immediately follow. It will be seen, however, that the computations based on the death rates cited in the text are used, not to ascertain the relation between population and births, but rather as a means of comparing the ratio between the number of children born and the number surviving at the end of a five year period in the country as a whole, with the corresponding ratio for cities. It is believed that for this purpose the assumptions are valid; that the results obtained will not differ essentially from and will be as useful as any results that might be obtained through further manipulation of the rates, or through the application of more complicated mathematical processes.

* Census of 1910, *Abstract*, p. 55.

number of births per 1,000 population for the country as a whole was approximately 26.9 and the corresponding figure for the cities 23.8.

The death rate for the total population has been fixed at 15.7 per 1,000; that for city population at 16.2. As in cities the birth rate is lower and the death rate higher than the country as a whole, the rate of natural increase of city populations must be materially less than the rate of natural increase of the whole population. The difference may be measured, approximately, by comparing birth rates with death rates. For every 1,000 persons in the total population there were 26.9 births each year and 15.7 deaths; the births exceeded the deaths by 11.2 per 1,000, and this last ratio represents the approximate natural increase. In city populations, on the other hand, there were 23.8 births each year and 16.2 deaths per 1,000; hence the natural increase for city populations was 7.6 per 1,000.

This last figure is not presented as a measure of the actual annual increase in city populations. Because of the many assumptions involved in the computations the use of the ratio for such a purpose would be imprudent. The ratio is offered, in connection with the corresponding ratio for the country as a whole, to show the relation between natural increase for the country as a whole and the natural increase of city populations.

An annual natural increase of 7.6 per 1,000 is 67.9 per cent. of a natural increase of 11.2 per 1,000. It has been seen that the natural increase of the total population from 1900 to 1910 was 14.0 per cent. The natural increase in city populations for the ten-year period should be about 67.9 per cent. of 14.0 per cent., or 9.5 per cent.

The urban population in 1900 was 31,609,645. A gain of 9.5 per cent. would amount to 3,002,916. As the total increase in urban population from 1900 to 1910 was 11,013,738, the fraction of this gain due to natural increase was, on the basis indicated, 27.3 per cent.

It is obvious that the figures just given do not represent the natural increase with exactness. Mention has already been made of the assumptions on which the various computations are based, and of the possible influence of the migration of

children under five years of age on the results. If, as is quite probable, the migration of young children from country to city exceeds the corresponding migration from city to country, the urban birth rate, the urban rate of natural increase, and hence, the proportion of urban gain due to natural increase, as estimated, are slightly too high. The figures given represent not the exact, but the approximate gain from natural increase. While it does not seem advisable to attempt to fix definite limits within which the true figure is to be found, the approximation is believed to be a fairly close one.

Migration from Country to City.—Of the three sources of urban growth two have now been considered—alien immigration and natural increase—and figures and estimates have been presented. As to the contribution made by the third source, migration from country to city, no direct evidence is available. It is clear, however, that whatever portion of the total increase is not traceable to one of the first two sources, must arise from the third. As has been seen, the total urban gain from 1900 to 1910 was 11,013,738. The maximum contribution made by alien immigration has been fixed at 4,090,514, while the gain from natural increase has been estimated at 3,002,916. If these figures may be relied upon, the minimum gain due to migration from country to city was 3,920,308 (the difference between 11,013,738 and the sum of 4,090,514 and 3,002,916), or 35.6 per cent. of the total increase. And as the minimum contribution of alien immigration has been estimated at 3,308,091, the maximum contribution of migration from country to city may be placed at 4,702,731 (the difference between 11,013,738 and the sum of 3,308,091 and 3,002,916), or 42.7 per cent. of the total gain.

Summary and Conclusions.—The estimates presented in the foregoing paragraphs are repeated in graphic form in the accompanying diagram. The increase in urban populations from 1900 to 1910 was 11,013,738. This increase has been distributed as follows: Alien immigration, from a maximum of 4,090,514, or 37.1 per cent. of the total increase, to a minimum of 3,308,091, or 30.0 per cent. of the total; natural increase, 3,002,916, or 27.3 per cent. of the total increase; and migration from country to city, from a minimum of 3,920,308,

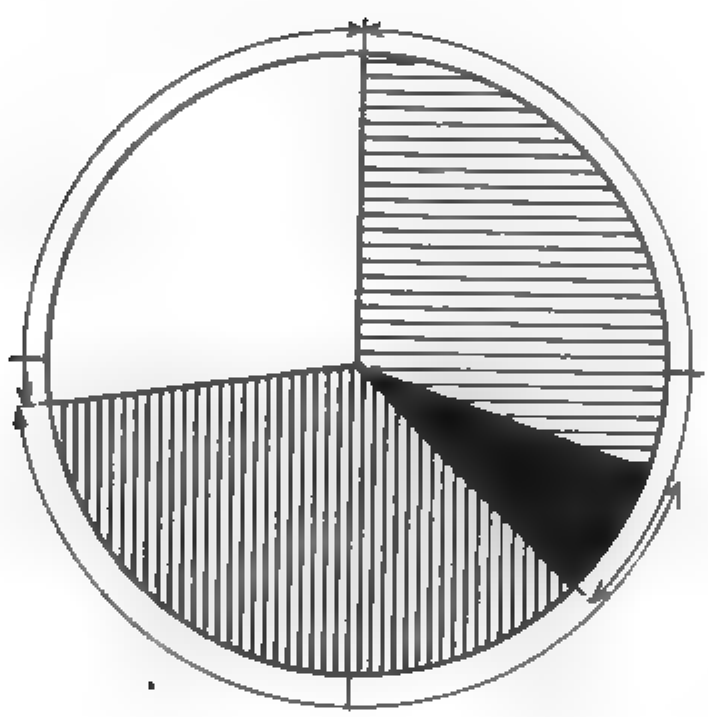
or 35.6 per cent. of the total increase, to a maximum of 4,702,-731, or 42.7 per cent. of the total.

In view of the estimates and assumptions involved, the results of this study are to be accepted with a certain reserve. The Census figures seem to show that not over three eighths of the gain in urban population from 1900 to 1910 was due to alien immigration. As to the other matters considered the evidence is less definite. It is believed, however, that the statistics presented support the general conclusion that the part of the urban gain due to alien immigration probably did not fall short of three tenths of the total, that the contribution made by natural increase amounted to slightly over one fourth of the total, and that the gain from migration from country to city amounted to between one third and four ninths of the total gain. The inference seems permissible that alien immigration was not, in any sense, the preponderant source of urban growth. There is reason to believe that less than half the total gain arose from this source, and that the most potent single factor was migration from country to city.

Urban Increase from 1900 to 1910
In numbers, 11,013,738 persons

Natural increase: 27.3 per cent.

Alien immigration: maximum, 37.1 per cent.; minimum, 30.0 per cent.



Migration from country to city: maximum, 42.7 per cent.; minimum, 35.6 per cent.

A STUDY OF THE CAUSES OF INDUSTRIAL ACCIDENTS.

By Gustavus Myers.

Since the adoption by twenty-four states within the last few years of workmen's compensation laws, the opportunities for securing data as to the frequency and causes of industrial accidents have been greatly increased. Previous to the passage of those laws and of the appointment of commissions to administer them, there was no system in force under which any state received and arranged reports of all accidents taking place in industrial establishments, and this was true of fatal as well as non-fatal accidents. Occasional investigations might be made here and there by special official bodies, but there was no provision for permanent inquiry and report.

In at least two branches of the subject—those pertaining to accidents on railroads and in mines—record was kept of accidents, but this was done by federal officials; in the one case by the Interstate Commerce Commission, in the other by the Bureau of Mines. As for accidents in purely industrial concerns, nothing even approaching an adequate record was kept, and there were neither requirements nor facilities for keeping any.

When, however, the passage of workmen's compensation laws brought permanent commissions into existence, there were created continuing agencies among the functions of which were the assembling and reporting of all necessary data. Necessarily, each of these commissions, operating under differing laws, produces an absence of uniformity, and this applies to specific provisions of law as well as to methods. Some of the commissions will make exhaustive reports while others give no detailed statistics, but so far content themselves with reporting merely the main outline of facts. In some states a system of the most thorough reporting and tabulation has been put in operation under the supervision of skilled statisticians; in other states this system has not yet been introduced.

Nevertheless, making full allowance for these deficiencies, there is already supplied a mass of data affording certain authentic information. If there is any one phase of the matter of industrial accidents long a prolific source of conjecture, contention, and extravagant assertions of one kind or another, it has been that regarding the factors causing them. What proportions are due to inherent risks of industry, and what to personal fault? Approximately what percentage is chargeable to employers, and what to employees? To what extent do unsafe machinery, lack of proper safeguards, flying objects, perilous speeding up, and other factors, on the one hand, and on the other, personal carelessness, enter into the causative nature of industrial accidents? Upon one or more or all of these questions various assumptions have been and are still being made. The data at hand in the official reports are manifestly not conclusive of the situation in the United States as a whole. Much of it, too, is incomplete and requires further elucidation. Still, there remains a valuable body of reliable statistics containing significant essentials well worthy of consideration.

When, in 1908, Frederick L. Hoffman, basing his estimate upon the data then available, conservatively placed the number of deaths due to industrial accidents at 30,000 to 35,000 a year, and casualties of all kinds in the United States at 2,000,000 annually, the assumption was advanced that at least 50 per cent. of these mortalities and injuries "were the direct result of the occupational risk." These figures, published in Bulletin No. 78 of the U. S. Bureau of Labor, September, 1908, attracted widespread attention. In Bulletin No. 157, issued by the U. S. Bureau of Labor Statistics, in March, 1915, Mr. Hoffman concludes, after an exhaustive consideration of the returns, that "There are approximately 82,520 deaths per annum in the United States, from accidents due to all causes, and that of this large number of deaths some 25,000 may safely be assumed to represent the loss of life directly due to occupational activity, chiefly in connection with the carrying on of dangerous industries, all of which are typical of the economic necessities of modern life." The estimate by Carl M. Hansen, Secretary of the Department of Accident Preven-

tion, Workmen's Compensation Service Bureau, is somewhat different. In an address recently delivered before the National Association of Cotton Manufacturers, Mr. Hansen estimated that from 40,000 to 45,000 wage workers were killed by accidents in the United States annually. The Massachusetts Industrial Accident Board has placed the number of workers in the United States killed by accident yearly at 75,000 and the number of injured every year at 3,000,000. Estimates may vary, but the number killed and injured annually is self-evidently enormous.

Is the old assumption that about one half of these casualties are due to risk of industry practically correct? Is it an exaggeration or an under estimate? Examining the reports of the various state commissions administering workmen's compensation laws with respect to this particular inquiry, we get a scattering of some definite results based upon such casualties as have been reported.

The New York State Workmen's Compensation Commission began actual operations on July 1, 1914. The first annual report contains no statistics on the causes of the accident cases passed upon by the Commission, but the promise is held out in this report that "the commission will maintain a small but well organized statistical department which will analyze claims to discover the causes of accidents, and by promulgating the information thereon, offer a constant incentive to employers to adopt safety methods and devices, on the theory that it is better to prevent an accident than to compensate the losses arising therefrom." Up to January 1, 1915, the following number of injuries were reported, awards allowed, and claims pending:

Number of notices of injury filed by employers	130,723
Number of claims received from employees	22,221
Number of claims in which initial awards were allowed	15,218
Number of claims in which subsequent awards were allowed	3,712
Total number of awards allowed	18,930
Number of claims disallowed	982
Number of claims pending	2,707
Number of completed claims set for hearing	2,314

No figures are given for the number of cases having fatal results. The report comments that although more than 130,-

000 workmen were injured during the 7 months from July 1, 1914, to January 31, 1915, only 22,221 claims for compensation were made. The principal reason for this disparity, it says, is that the law allows compensation only for such injuries as result in disability for more than fourteen days. Another reason was that many of the notices of injury applied to persons who were not in employments covered by the law; and a third reason is the fact that some reported injuries were sustained prior to July 1, 1914, and were therefore not compensable.

Although further reports must be awaited giving detailed statistics of accident causes in New York State, yet there is one vital fact already available from the records of the Legal Department of the New York State Workmen's Compensation Commission, throwing much light upon the mooted question of personal negligence. In view of the provisions in the New York Workmen's Compensation Act making intoxication a cause of exclusion of awards, it is important to inquire into the results. The Legal Department says that there were but a very small number of cases—perhaps not more than a hundred in a total of 18,930 awards allowed, in which the question of intoxication was raised by either the employer or insurance carrier, and that in not a single case did the Commission decide that the injuries were due wholly to intoxication, nor was a single claim disallowed on the ground of intoxication. It is evident that this element so frequently alleged as a fertile cause of accidents was not observable in the investigations made in New York State. The hope may be expressed that in its next report the New York State Workmen's Compensation Commission will present facts as to what causes do produce accidents, and also give what is lacking in its first report, the sex and ages of the total killed and injured, and months, days, and hours when the injuries happened.

The reports of the Commissions of certain other states likewise give no positive statistics on the causes of accidents, but merely register the aggregates of claims submitted and passed upon.

The Connecticut Board of Compensation Commissioners commenced active operations on January 1, 1914. Up to

November, 1914, there were reported in Connecticut 18,054 accidents, of which, the Commission reports, a very large number either did not incapacitate the injured employee from labor at all, or if at all, for periods of less than two weeks. The number of compensation agreements voluntarily entered into by employer and employee and approved by the Connecticut Commission, amounted to 3,444.

The Michigan Industrial Accident Board employs no statistician, explaining that it has no funds for the purpose. The total number of accidents reported during 1914 to the Michigan Board was 33,315, of which 290 resulted fatally. Of the 33,315 cases, nearly 20,000 did not receive compensation, for the reason that the disability continued for less than two weeks, which is the waiting period under the law. Under the rules of the Michigan Board, no case is reported unless the injury is sufficiently severe to cause total disability of at least twenty-four hours, or which results in the loss of a member or death.

The first annual report of the Texas Industrial Accident Board is similarly meager in statistics. The Employer's Liability Act in Texas became effective on September 1, 1913. During the fiscal year ended August 1, 1914, there was a total of 18,888 injuries reported, 81 of these injuries resulted in death. During this period 4,000 injured employees received compensation, and an aggregate of 7,091 received either compensation with medical aid, or medical aid only. The total number of employees of 2,844 subscribing employers in Texas, on September 1, 1914, was 95,808. Subscription to the Texas Act is not obligatory on employers, and from its provisions are exempted domestic servants, farm laborers, employees of operators of railways as common carriers, laborers engaged in working for cotton gins, and employers of less than 6 employees. The Texas Industrial Accident Board recommends that the Act be so amended as to apply to all employees excepting only domestic servants, farm laborers, and railway employees. The first report of the Texas Industrial Accident Board is concerned largely with pointing out evils that have developed, with suggestions for changes, and explanatory statistics of accidents are excluded. One of the many complaints made by this Board is of especial interest. It declares that "in a

very large number of cases it has come to the knowledge of the Board that attorneys have been employed at a cost to the employees of one third and, oftener, one half of the compensation to which they were entitled, and secured by assignments of an interest in the compensation. . . . Instances have become known to the Board where the contract between the attorney and the employee also provided that all compensation shall be paid directly to the attorney." The Board asks for authority to declare invalid all such assignments or transfers of compensation by employees.

The first year of reports under the Workmen's Compensation Act in Minnesota was 1913–1914. During this year, according to the report of the Minnesota Department of Labor and Industries, there were 149 fatal accidents and 12,084 non-fatal accidents. Of these 211 were females, two of whom were injured fatally. The following table shows the industrial accidents in Minnesota by industries in 1913–1914:

Industry.	Fatal.	Non-fatal.
Railroad shops	2	809
Mining	42	2,252
Lumber and U. W.	22	2,428
Contracting	21	1,730
Public utilities	[illegible]	506
Agriculture	12	203
Flour manufacturing	5	313
Foundries and machinery	[illegible]	1,093
General manufacturing	10	892
Mercantile	6	852
Miscellaneous	11	974
Totals	149	12,084

A striking fact dealing with the question of frequency of accidents is that the non-fatal accidents in Minnesota increased from 5,442 in 1912–1913 to 12,084 in 1913–1914, and the totals of fatal and non-fatal accidents from 5,578 to 12,233. This increase is explained by the activity of the state's inspectors in calling the attention of the employers to the accident report law. The ages of 7,114 injured employees in all industries in Minnesota in 1913–1914 were:

Age Groups.	Number.	Per Cent.
14 to 16 years	45	.65
17 to 21 years	904	12.70
22 to 30 years	3,062	43.00
31 to 40 years	1,762	24.80
41 to 50 years	918	12.90
51 to 60 years	320	4.50
60 years and more	103	1.45
Totals	7,114	100.00

A companion table in the report shows that of a total of 5,701 injured, 15.25 per cent. were occupied less than one week at the work on which they were injured; 14.65 per cent. less than one month; 37.50 per cent. from one month to one year; 22.20 per cent. from 1 year to 5 years; 6.50 per cent. from 5 to 10 years; and 3.90 per cent. 10 years and more. Evidently inexperience is a very considerable factor in causing accidents. Although Part III of the 1914 Report of the Minnesota Department of Labor and Industries gives 22 tables of statistics, none of them, unfortunately, covers the specific causes of accidents. In the "Minnesota Bureau of Labor Bulletin on Industrial Accidents and Workmen's Compensation," Don D. Lescohier, Expert of the Minnesota Bureau of Labor, assigned 71.6 per cent. of industrial accidents to hazards of industry, and 5.2 per cent. to contributory negligence. In another article, published in June, 1911, Mr. Lescohier stated that Minnesota employers reported that fully 60 per cent. of all accidents were due to dangers inherent in industry," a conclusion almost identical with that reached by the "Minnesota Bureau of Labor in a previous publication." Mr. Lescohier declared that more than 50 per cent. of the accidents that occur were certainly preventable. Continuing, Mr. Lescohier pointed out that "the principal causes of accidents found responsible in whole or in part for the 38 per cent. of the accidents attributed to the workmen, were youth, ignorance of the English language, incompetence, carelessness, ranging all the way from momentary inattention or forgetfulness to foolhardy recklessness, personal shortcomings, like deafness, or excitability and absorption in the work at hand which make the workman oblivious of approaching danger, fatigue, and nerve strain."

Such statistics as are given of the first year's operation of the Minnesota Workmen's Compensation Act seem to show that the great proportion of the cases open to compensation were not contestable on any ground. The large number of cases in which the workman was disabled for less than two weeks were not entitled under the law to compensation. Deducting these, left 3,634 cases subject to the compensation provisions. By June 30, 1914, the end of the fiscal year, all payments were made in 2,468 or 67.6 per cent. of the cases, and settlements were in process in practically all of the remainder.

The New Jersey Workmen's Compensation Law was enacted in 1911. Section 1 of this Act allows compensation "providing the employee was not guilty of negligence." Section III defines negligence: "For the purposes of this Act, wilful negligence shall consist of (1) deliberate act or failure to act, or (2) such conduct as evidences reckless indifference to safety, or (3) intoxication as the proximate cause of injury."

In the years 1911–1913 the total number of non-fatal accident reports received in New Jersey was 6,635, and in the following year 5,750. In the year 1912–1913, there were 233 fatal accidents reported. The New Jersey Employers' Liability Commission complains in its 1914 report of the great laxity in the reporting of accidents by employers. "This is evident," it says, "from the fact that while there are, according to the records in the Department of Labor, about 5,000 manufacturing employers in the state, we have only received reports from about 1,000."

This may reasonably be interpreted as an acknowledgment that there is probably a much greater frequency in accidents than is officially registered. Of 4,276 cases entitled to compensation in 1913, the greater part were settled promptly. The report of the New Jersey Employers' Liability Commission contains no statistics or explanations of the causes of accidents. It declares, however, that "the fact that of all the cases reported as compensated, 93.2 per cent. were settled automatically, *i. e.*, without reference to a court, speaks well for the law." This fact evidently shows that wilful negligence, whether in the form of intoxication or in the other ways de-

scribed in the Act, was so nearly absent as a factor as to be dismissed from consideration. The merits of such cases as were contested are shown in the further fact that of a total of 293 cases taken in 1913 to the Court of Appeals (deducting 12 cases dismissed or compromised before the final hearing), only three cases of the entire number were refused.

The reports of the Massachusetts Industrial Board, although not giving many statistics with reference to the question of personal fault, nevertheless present certain facts of value. From July 1, 1912, to June 30, 1913, there were in Massachusetts a total of 84,694 non-fatal accidents, of which 72,862 were insured. During the same period, the fatal accidents totalled 474 of which 290 were insured. Of the non-fatal accidents, 29,737, or 33 per cent. of the total number, were caused by hand labor, 11,375, or 12 per cent., by machinery peculiar to special industries, 8,417, or 9 per cent., were the result of falls of various kinds, 4,331, or 4 per cent., were eye injuries, and 102, or 0.1 per cent., were occupational injuries (diseases). The heaviest causes of fatal injuries were due to railroad equipment, falls, vehicles, hand labor, elevators, electricity, and street railways. As a factor entering into the causes of industrial accidents, the report states that "dusty trades, industrial poisons, and occupational diseases are responsible for an annual loss in the United States of $750,000,-000, through needless diseases and disablements, and Massachusetts has her proportion of this enormous waste. The great majority of wage earners spend at least one third of every twenty four hours in the factory, mill, or shop. Conditions in many of them are such that the worker is unable to attain fullest efficiency by reason of the conditions which surround him, and this has a direct bearing upon the number of accidents or the quality of the output of the worker. . . ."

Massachusetts is one of the few states in which statistics have been officially gathered as to the time of accident happenings. The 1914 report of the Industrial Accident Board of that state gives these totals of the days on which fatal accidents happened during the year in the industries in that state:

Monday	72
Tuesday	90
Wednesday	76
Thursday	79
Friday	76
Saturday	63
Sunday	18

In view of the assertions frequently made that Monday is the principal accident day, due to the effects of "Sunday celebration," these statistics, showing results contrary to that view, are instructive. The statistics given for the year for non-fatal accidents for forty-one industries, transportation systems and occupations in Massachusetts are:

Monday	16,309
Tuesday	15,465
Wednesday	14,871
Thursday	15,014
Friday	15,295
Saturday	11,217
Sunday	1,523

Considered as an aggregate these figures would seem to show that more non-fatal accidents happened on Monday than on any other day. But a scrutiny of the figures applying to each industry reveals that in the woolen and worsted mills, rubber factories, print works, rope and cordage factories, and in other plants, there were more accidents on Tuesday and often on Tuesday, Wednesday, and Thursday, than on Monday. The Industrial Accident Board notes that "except for Saturday and Sunday, when a small number of employees are working, the daily frequency of accidents is very steady." So far as wilful negligence (including intoxication) may enter into the matter of personal fault, there is, judging from the returns, hardly any of it admixed with the causes of industrial accidents in Massachusetts. Of 156 cases contested by appeal to the arbitration committees or to the Courts, from July 12, 1912, to June 30, 1913, there were only four cases in which there was any charge of intoxication, and in only two cases were claims denied on that ground.

In Ohio the elective Workmen's Compensation law went into operation on March 1, 1912, and the later enacted, so-called compulsory law, on January 1, 1914. The 1915 annual report of the Industrial Commission of Ohio states that for the year ended November 15, 1914, there were 68,869 claims filed, 306 of them death claims. Of these, 58,317 had been disposed of by that date. Under the head of "Causes of Accidents," the only statistics given in the 1915 annual report are these:

Cause to which Ascribed.	Number of Accidents.	Per Cent. of Total.
Falling and shifting objects	19,606	36.7
Machinery	14,018	26.3
Hand tools and simple apparatus	5,231	9.8
Nature of material used or similar working conditions	4,900	9.2
Falls	4,774	9.0
Carrying, lifting, or handling great weights	1,196	2.2
Transportation on tracks	912	1.7
Transportation not on tracks	699	1.3
Animals	457	.9
Suffocation and asphyxiation	139	.3
Sunstrokes and heat prostration	107	.2
Intentional violence of fellow employee	41	.1
Intentional violence of persons not employees	34	.1
Not otherwise classified	1,254	2.3
Total	53,368	100.0

Further in the report, however, under the section describing the Board's inspection division's activities in workshops and factories, the emphasis is placed upon the pressing need of safeguarding machinery. After itemizing 26,662 inspections made, the report comments: "It will be noted from the above that a large portion of the work of the division during the past year was devoted to factory inspection, special attention having been given to the matter of safeguarding machinery and the prevention of accidents. Very commendable progress has been made along this line, there being a marked decrease in the number and the seriousness of accidents occurring in industrial establishments." There are various other remarks in the report on the steps taken to insure better and safer working conditions for the workmen in the industrial establishments and also in the mines of Ohio. The whole trend of this report seems to remove the larger number of accidents from the domain of personal fault and places the responsibility for

them upon lack of proper safeguards or other conditions outside of the control of the workers.

The Wisconsin Workmen's Compensation law is an elective one; by June 30, 1914, 12,500 employers, with about 250,000 employees, were under its provisions. Reports of all accidents, causing disability of more than 7 days, together with the cause and nature of the injuries, are required from employers. The Wisconsin law, it may be noted, penalizes intoxication 15 per cent. In the year ended June 30, 1913, a total of 8,224 accidents were reported to the Industrial Commission of Wisconsin, of which number 4,526 cases were reported as not being subject to compensation provisions. Of a total of 3,571 cases of accidents in establishments of private employers, 2,781 cases were at once settled and compensation was paid by those employers without an order of the Industrial Commission. This would clearly appear to argue that all of those cases were of so manifestly meritorious a nature, that no charge of wilful misconduct could be interposed as an objection to payment. Of the remainder of the 3,571 cases, many were cases in which compensation was not claimed, and in other cases the hearings were still open or the claims were pending.

During the year ended June 30, 1914, there were reported to the Industrial Commission of Wisconsin, 11,148 accidents. Of this number 10,127 accidents in establishments of private employers were under compensation, and of these, 8,090 cases were settled and compensation paid without any order of the Commission. In 1,386 claims the cases were still open; in other cases hearings were still pending, and in 777 cases compensation was not claimed. If the provision (in effect since June, 1913) whereby an employee injured because of intoxication should have his compensation reduced 15 per cent. was inserted on the supposition that drunkenness was a frequent cause of accidents, that theory has been anything but confirmed by the returns. The records of the Industrial Commission of Wisconsin show that in only 4 or 5 cases out of the 18,139 cases up to January 1, 1915, has the employer made any claim that the employee was intoxicated, and in only one case has the Commission found that the injury was caused by intoxication. In view of these returns, the question of intoxi-

cation is not to be seriously considered as a direct cause of industrial accidents in Wisconsin.

What, then, are the causes? The Industrial Commission of Wisconsin devotes may pages of its report to a description of the work it has done in placing safety-promoting information in the hands of employers. This information deals with the safeguarding of machinery. Numerous employers, the Commission announces, are adopting these safety suggestions. "Many companies have made very substantial reductions in accidents as compared with their records five years ago. For instance, the Fairbanks-Morse Manufacturing Company of Beloit, has reduced accidents 72 per cent.; the Chicago and Northwestern Railway Company over 30 per cent.; the Illinois Steel Company, of Milwaukee, 70 per cent.; the Bucyrus Company, of South Milwaukee, 46 per cent.; the A. J. Lindeman-Hoverson Company of Milwaukee, over 50 per cent.; and the Allis-Chalmers Manufacturing Company of West Allis, over 50 per cent."

Nevertheless, even with this widespread coöperation of many employers, violations of safety and sanitary laws on the part of other employers persist. Of a total of 2,496 establishments inspected in the year ended June 30, 1914, violations were found in 1,487. The most serious aspect of the accident situation, the Commission reports, is the large class of accidents where, in nearly every case, the use of a mechanical guard is impossible by reason of the circumstances. The following is a list of such accidents during the 31 months from September 1, 1911 (when the safety law went into effect), to April 1, 1914:

Danger Points.	Number of Accidents.	
	Total.	Average per Month.
Cranes and derricks	165	5+
Explosions	191	6+
Escaping steam	77	3−
Hit by flying nails and chips	623	20+
Hit by hoisted or moving objects	1,121	36+
Hit by vehicles, cars or trucks	583	19+
Hit by objects falling from piles	1,412	45+
Hit by falling trees or limbs	260	8+
All other hits	874	28+
Falls downstairs	123	4−
Falls from ladders	268	8−
Falls from scaffolds	374	12+
Falls from buildings	93	3+
Falls into excavations	87	3−
Falls from wagons, cars, etc.	569	18+
Falls from boxes, chairs, etc.	55	2−
Slipping or stumbling	1,073	35−
Falls into vats, pits, holes, etc.	96	3+
Falls from poles, poles or trees, etc.	120	4−
Falls from tramways and trestles	37	1+
Falls from runways, loading platforms, etc.	93	3+
Other falls	197	6+
Handling heavy objects	2,640	85+
Teaming and trucking	349	11+
Animal bites and kicks	188	6+
Hand tools and apparatus	1,403	45+
Stepping or kneeling on nails, etc.	900	29+
Other similar causes	513	16+
Total	14,480	467+

The Commission comments that it requires only a glance at these accident statistics to convince one of the impossibility of framing specific laws to prevent them without prohibiting most of the operations altogether, and says that the problem of prevention lies preëminently with this class of accidents.

The reports of the Industrial Commission of California give ample statistics and explanatory comment. In 1911, a law called the Roseberry Act, was passed, but it was recognized as merely a crude beginning. Its purpose was chiefly formative and educational. The Industrial Accident Board created by this Act, complained, in its annual report for 1912, of inadequate powers conferred upon it by the Act. For the year ending December 31, 1912, there were 10,835 accidents reported. These represented only the accidents causing disability of more than 7 days. Of the 10,835 accidents reported, 9,627 were tabulated; of these 2,547 were railroad accidents (of which 106 resulted in death and 83 in permanent disability), and 7,080 accidents in other industries causing 306 deaths and 451 cases of permanent disability.

Impressed by the great number of accidents, the California Industrial Accident Board urged in its report that, "Our statistics show that in California we kill four times as many as we should but California has done nothing in the way of safeguarding its working people against needless dangers. There are literally no laws requiring machinery to be made safe. If the legislature will give the Industrial Accident Board power and authority to make the employments and places of employment as safe as they reasonably can be made, it will undertake, within five years, to reduce by one half, the number of serious and fatal accidents that would otherwise take place, and greatly to diminish injuries of a minor character. . . . "

In 1913, there were 12,031 accidents in California tabulated. These were all accidents causing disability of more than 7 days. Of this number, 890 resulted in permanent injury, and 555 fatally.

The legislature, in 1913, enacted the Workmen's Compensation Insurance and Safety Act. Under this law, operative from January 1, 1914, the Industrial Accident Commission was created to supersede the Industrial Accident Board. The Commission formulated new rules and regulations regarding the reporting of accidents, requiring reports of every accident which disabled throughout the day or which required medical attention, and also reports from every employer in California, including domestic, farm, and casual labor, which branches previously had not been covered.

The latest published annual report of the California Industrial Accident Commission deals, as far as the year 1914 is concerned, with the first six months of that year only. During this period, 26,958 industrial accidents were reported, of which 14,589 were non-compensable cases. Of the 26,958 accidents, 25,991 were cases of temporary injury, 698 cases of permanent injury, and 269 were cases terminating fatally. There were really 291 fatal accidents, but the Commission explains that considering the difficulty of getting complete information in 22 cases it uses the number 269 in most of the analytical tables.

In a study of these accidents, the Commission says:

"Roughly speaking, the causes of accidents fall under two heads: Those accidents that are caused by some mechanical device that is driven by man or horsepower; the other large class is that caused by some form or condition of hand labor. The former class of accidents can be reduced in a large measure by protective devices; the latter, by a campaign of education that will teach the employees that it is bad to lose money and time, but it is worse to suffer pain and mutilation of the body." Of the 291 fatal accidents, the largest number, 48, occurred on general construction work; 38, on steam railways; 33, in the lumber industry; 29, in mining and smelting; 27, in agriculture; 23, in power and light manufacturing and distribution; 19, in wharfing and shipping; and the remainder in various industries. The Commission calls particular attention to the accident mortality in agriculture, and explains that machinery is used so extensively on ranches and in dairying and kindred pursuits, that serious mangling by a mowing or pumping machine is not infrequent. Working around dangerous animals is also a cause of injury or death, the Commission notes, as the returns show. The causes of the fatal accidents in California during the first six months of 1914, are thus given:

Causes of Fatal Accidents.

		Numbers.
Falling, Rolling and Flying Objects		66
Falling rocks, limbs and pieces of timber	24	
Cave-ins	18	
Rolling poles from cars	15	
Unloading and moving objects in shop	9	
Collisions and Derailments		60
Run over by train or vehicle	28	
Hit by train or vehicle	19	
Collision of trains, cars and vehicles	9	
Run over by trains while boarding	2	
Run over by "skip" in mine	1	
Derailment of coaches	1	
Falls		57
Into unprotected skylights and from unprotected scaffolds, etc.	37	
Into shafts and from ladders	9	
Slipping and falling	5	
Due to collapse of staging	4	
Due to shock	1	
While jumping from train	1	

Dangerous Substances		48
Contact with live wires	22	
Gas explosions and blastings	10	
Poisoning gases	8	
Explosions of boilers and steam pipes	5	
Infections from nail wounds	2	
Squirrel poison	1	
Drowned		27
Machinery and its parts		11
Unprotected revolving shafts	3	
Unprotected belts and pulleys	2	
Unprotected circular saws	2	
Unprotected flywheels	2	
Unprotected gears	1	
Defective becket	1	
Elevators, hoisting apparatus, lines, etc.		10
Altercations		6
Animals		2
Cause unknown		2
Tool		1
Intoxication and falling into shaft		1
Total		291

It will be noted from the foregoing table that flying, rolling, and falling objects caused the largest number of deaths, and that unprotected places and apparatus were also a large cause. There is only one case of wilful misconduct, under the form of intoxication, noted. The causes of accidents in California resulting in permanent injury were, in general, the same, as follows:

Causes.	Number.
Power-driven machines	250
Shopwork, handling heavy objects, flying fragments and falling bodies	251
Collisions, falls from ladders and on stairs, jammed in doors	86
Tools	62
Elevators, derricks, winches	59
Animals	9
Unknown	1
Total	698

Many of these accidents, especially to the eyes, the Commission says, could be avoided by very simple and inexpensive means. "It is generally thought," the Commission states, "that the major part of those killed and permanently injured are men who are old and clumsy, or who have grown careless with years. The contrary is true. Industry, like war, crushes the flower of its army. According to graph No. V, 254, or approximately 36 per cent. of those who received permanent injuries, were 20 years of age. No distinction of sex is recognized; but 12 girls and women are numbered among those who were crippled by machinery. The average age of those permanently injured was 34 years."

Of the 25,991 temporarily disabled in California during the first six months of 1914, the principal causes were:

Causes.	Number.
Hand labor	7,572
Falls	4,051
Falling objects	3,438
Eyes	2,109
Machinery	1,330
Nails	1,324
Burns and scalds	1,079
Vehicles	951
Infections	805

The causes of the remainder of the cases given in the table were animals, railroad-equipment, glass, saws, elevators, electricity, street railways, and various effects of power-driven machinery. Of the 3,959 injuries received in six months, in general construction, the report says that "the common hazard of general construction is poor staging quickly constructed, a one- or two-plank scaffold with no guards, lax rules governing the disposition of refuse lumber, bricks, etc., new stairways and openings left unprotected." The same hazards, the report states, were responsible for the 3,312 injuries to workmen, in six months, in the construction and operation of steam railways in California.

An instructive table, presented in the California report, is

that dealing with the frequency of non-fatal accidents occasioning temporary disability, by the day of the week. The 25,991 such accidents during the first six months of 1914 occurred by days as follows:

Sunday	1,339
Monday	4,431
Tuesday	4,236
Wednesday	3,919
Thursday	3,997
Friday	4,118
Saturday	3,874
Unknown	77
Total	25,991

These statistics show, like those of Massachusetts, a fair degree of daily uniformity in the frequency of accident occurrences. Tuesday's and Friday's lists are almost as large as Monday's, and on certain other days the number is not far behind. No substantiation is found in these returns for the extreme assertion so often made that the bulk of accidents happen on Monday and are the result of the use of alcohol on Sunday. The California report gives no interpretation of the figures, but the explanation offered by Dr. I. M. Rubinow in his volume "Social Insurance" has force. "The suggestion has never been offered," he says, "that changes of occupation occur usually at the end of the week and the new work is begun on Monday, and the lack of familiarity with the new machine or with the new place of work is a fruitful cause of accidental injuries. . . . "

The California Industrial Accident Commission notes with satisfaction that since January 1, 1914, 3,019 farmers, 484 employers of domestic labor, and 344 employers of casual labor have voluntarily accepted the provisions of the Compensation Act, bringing under its protection approximately 30,000 casual, domestic, and farm laborers. The report points out the frequent risks confronting these laborers in the performance of duty.

The Nevada Workmen's Compensation Act is, like that of

Michigan, elective, but compulsory as to public employees. By December 31, 1914, there were 813 employers and 10,709 employees under its provisions. The 1915 annual report covers 18 months, from July 1, 1913, the time the Nevada Industrial Commission began operations, to December 31, 1914. During this period there were 1,849 accidents, of which number 986 incapacitated the injured worker less than 2 weeks, and 53 fatal cases. Of the total number of accidents, 707 were compensatory. The greatest number of accidents—1,270—occurred in mining. The report gives no specific statistics or explanatory remarks throwing light on the causes of the accidents. It says, however, that very few claims were submitted which were without foundation, and that most of those without basis were filed under a misconception of the provisions of the law.

The annual report of the Industrial Insurance Department of the State of Washington gives a mass of itemized information, accompanied by many tables of statistics. The Workmen's Compensation Act in this state is now in its fourth year of operation. By September 20, 1914, there were approximately 9,980 firms and individuals, employing 176,420 workmen, under its provisions. From October 1, 1911, when the law went into effect, to September 30, 1914, there were 43,321 accidents reported, 974 of them fatal. Of the 43,321 accidents, 31,320 claims were passed for final settlement.

To what varying elements of fault were the bulk of these accidents due? The 1914 report gives this table of statistics for the fiscal years 1913 and 1914, considered with regard to the dominant factor in each case:

Fault.	Fiscal Year 1913.		Fiscal Year 1914.	
	Number.	Per Cent.	Number.	Per Cent.
Risk of trade	8,543	69.0	10,279	81.7
Workman's fault	951	7 8	906	7 2
Fellow servant's fault	303	2 4	399	3 2
Employer's fault	90	.7	31	.2
Foreman's fault	12	.1	16	.1
Third person's fault	30	2	25	2
Facts not ascertainable	2,461	19 8	928	7 4
Total	12,380	100 0	12,586	100 0

In its first annual report, that for 1912, the Industrial Insurance Commission of the State of Washington, under the sub-heading of "Intoxication," reported: "Framers of compensation acts in other states and of the Federal bills for railway employees engaged in interstate commerce have devoted considerable attention to intoxication as productive of work accidents. The records of this Commission do not show many cases of intoxication. In one instance, a section worker, while in an intoxicated condition, had evidently laid down on the track of a logging railroad, and lost an arm from being run over by an engine. In instances of reported intoxication the workman has denied it, although admitting having had a glass of beer or two or the like. The question is invariably raised 'what degree of intoxication should be necessary to either bar a claim or result in some penalizing reduction?' "

If intoxication did not enter as a causative factor, what did? The 1913 report, explaining that its figures were based as accurately as possible upon the reports of employers and employees, declared that 72.4 per cent. of all accidents were reported to have occurred under conditions where safeguards were not applicable, and that in only 22.8 per cent. of the accidents were safeguards considered applicable. The Commission systematically distributed information among employers as to safety protective apparatus and measures, and in May, 1914, began organizing safety committees in the various mills, factories, machine shops, and logging camps. The results, it announces, have been gratifying; in 1914 only 25.4 per cent. of all accidents were mechanical, compared with 32 per cent. in 1913. Of 3,200 mechanical injuries in the fiscal year 1914, there were 247 occurring on machines that were not safeguarded. The Commission points out that the laboring class in the State of Washington is drawn from all countries in Europe, and that in a majority of cases, the workmen are at first unable to understand the directions of the superintendent or foremen, "and are ignorant of the dangers of wearing loosely-fitting or torn clothing around moving machinery, as well as the hazards of the machines."

In the case of the 9,386 non-mechanical injuries in the State of Washington in the fiscal year 1914, the main causes are

the same as in certain other states. The greatest single factor was falling and moving objects, causing 2,726 injuries. Next came falls with a record of 1,882 accidents. Heat and electricity caused 306 accidents, and miscellaneous, 4,472.

Of the industries, lumbering, milling, etc., produced 5,957 of the total of 12,618 temporary total disabilities, likewise the largest number of temporary partial disabilities (101 in 174), also 745 of the 1,478 permanent partial disabilities, and 165 of the 350 fatal accidents. The Commission's 1914 report elucidates these facts. It says: "We wish to call the attention of the employers, engaged in the logging industry, particularly, to the hazards of defective lines and lead traps on blocks. In a great many cases parts of old defective cable are used to fasten the blocks, with the result that the fastenings break as soon as they are subjected to a heavy strain. A number of accidents, occurring in connection with logging railway operations, is due to lack of blocking in the frog and guardrails and the antiquated equipment in use. Devices which have been discarded by the railway companies years ago, as being too hazardous, are still being used on some of the logging railways."

These returns from the official reports of the Commission of a number of states present statistics the accuracy of which is open to no question. To present the facts concerning accidents on railways and in mines would necessitate much space, and would too greatly extend an article, already long; therefore, these branches of the subject must be left to a further article. The foregoing facts, however, may justify certain general conclusions.

One is that the assumption that at least 50 per cent. of all industrial accidents are due to inherent risks of industry is not overdrawn, but is a conservative statement of the facts. True, protective devices are being constantly introduced, but there still remains the large and dangerous field where safeguards are not applicable. And while the different commissions are actively pushing the campaign for safety apparatus, a new factor, apparently making for accidents, has been introduced in industry. This is the "speeding-up" system, compelling workers to labor at nerve-racking speed. The reports of the Interstate Commerce Commission show that excessive speed required is one of the greatest causes of accidents.

Evidently, the House Committee on Labor (63d Congress, 2nd Session), after taking much testimony on the subject of "efficiency systems," thought so, too; in the preamble of a bill forbidding the "speeding-up" system in government plants, "speeding-up" was condemned as productive, among other effects, of accidents. In the Army and Navy Appropriation Bill, passed March 4, 1915, Congress inserted a provision prohibiting the employment of the "speeding-up" system in government plants.

A second conclusion is that, although personal fault may, in its aspects of ignorance, carelessness, and inexperience, account for a given number of accidents, yet it is a very minor, almost a negligible factor, as far as wilful misconduct is concerned. The returns show that deliberate recklessness or intoxication is not frequent as a cause of accidents, and in fact is so exceedingly slight as not to require serious consideration in the analysis of the immense number of accidents occurring in the United States annually.

This conclusion seems to be further borne out by the statistics in the federal report dealing with the cases under the United States Workmen's Compensation Act of 1908. Of 406 contested cases in four years (in the total number of accidents, the majority of the claims of which were allowed) negligence or misconduct was alleged in 80 cases, and in only one case was intoxication charged, and that charge was not substantiated by the courts.

A third conclusion is that the number of accidents is much greater than has been usually supposed. The reports of a number of the commissions refer to the fact that they do not by any means receive reports of all accidents, and that their lists are but partial. In addition, the process of covering accidents in agriculture has only just been begun. This, hitherto, has been an entirely neglected field, and to a large extent is still. From the scanty statistics at hand, it is not even possible to make a conjecture what the approximate total in agriculture is. Rural regions present an entirely different social environment from that of cities, yet accidents occur there as in industrial centers, on railroads, or in mines, although what the proportion is remains a problem.

REVIEWS AND NOTES.

Economic Cycles: Their Law and Cause. By Henry Ludwell Moore. New York: The Macmillan Company, 1914. Pp. viii, 149. $2.00 net.

In his study of *Economic Cycles* Professor Moore has given added proof of the fruitfulness of the mathematical methods of curve fitting and measurement of correlation when applied to economic statistics. In his search for the law and cause of economic cycles he has subjected the available statistics of rainfall, crop yields per acre and total production, crop prices, pig-iron production, and general prices to rigorous examination, first, to determine the cycles if there be cycles, and second, to determine the degree of correlation existing between the various series of statistics beginning with rainfall and ending with general prices, the last named series being taken as the best barometer of the ebb and flow of business.

Professor Moore formulates the law of economic cycles as discovered in his investigation as follows: "The weather conditions represented by the rainfall in the central part of the United States, and probably in other continental areas, pass through cycles of approximately thirty-three and eight years in duration, causing like cycles in the yield per acre of the crops; these cycles of crops constitute the natural, material current which drags upon its surface the lagging, rhythmically changing values and prices with which the economist is more immediately concerned" (p. 149).

In judging the validity of the author's conclusion the statistical methods used are decisive. Professor Moore truly says that "the literature in which rhythmic phenomena are treated in a statistical way teems with fallacies and uncertainties. . . . for the method frequently adopted of smoothing the data is so arbitrary that one is at a loss to know whether, after all, the alleged periodicity may not, in fact, be due to the process of smoothing; and, in addition, one is left in doubt as to whether an indefinite number of cycles other than the particular one deduced might not, with equal or greater probability, be obtained from the same data" (p. 7). The method selected in the present instance is that of fitting a multiple sine function to the data, called harmonic analysis. The reviewer knows of no method that better satisfies the requirements or is more rigorous than the one applied. The Pearsonian coefficient is used for measuring the correlation. This is, also, the best available method.

The study opens with an examination of the data of annual rainfall in the Ohio Valley for the period 1839-1910. There is no secular trend, but there is a cyclical variation which is closely described by a function (consisting of the first five terms of Fourier's series) showing periods of 33, 16.5, 8 and 4 years, with the 33 and 8 year periods most strongly marked. The function thus derived is found to fit, also, the rainfall data of Illinois, a section more representative of American cereal production

than Ohio, for the period 1870-1910. The coefficient of correlation for the two series of annual rainfall in Ohio and Illinois for 41 years is 0.600.

The relation of crop yields per acre to rainfall in Illinois is then investigated. The crops considered are corn, oats, hay, and potatoes, constituting 93 per cent. of the crop acreage and 96 per cent. of the crop value in 1912. Wheat is omitted "because both spring and winter wheat are grown in the state, and the statistics of their relative yield and price are not given in the published material for the long record covered in our investigation." The secular trend in the yield per acre, which is considerable only in the case of corn, is eliminated from each series. The figures thus obtained are correlated with monthly rainfall statistics of the same years. The months showing the highest coefficients of correlation for a given crop are combined and called the "critical period" for that crop. The coefficients of correlation for the rainfall of the critical period of corn and the "cycles" of corn yield per acre (*i. e.*, secular trend eliminated) is 0.589; for oats, 0.290; for hay, 0.620; for potatoes, 0.666. These high coefficients indicate that yield per acre is to a very great degree dependent upon the rainfall of the critical period. Of course, the coefficient merely tells us that the two series fluctuate together; common observation must be relied upon to designate the cause and the effect.

The data for the four crops are then combined to get indices of crop yield in general, allowance being made for the different degrees of fluctuation by using the respective standard deviations as the units of measurement. The general crop indices thus found are correlated with the mean effective rainfall of the critical periods. The resulting coefficient, $r=0.584$, shows that the yields of representative crops and rainfall are highly correlated.

The final stage of the first part of the investigation is reached in an examination of the accuracy with which the rainfall curve having 33 and 8 year cycles describes the crop yield per acre. Professor Moore recognizes that the rigorous method is to obtain the curve describing the crop yield independently and then compare the curve found with the rainfall curve. The laboriousness of the rigorous process caused him to use a substitute method, *i. e.*, to fit the function describing the rainfall cycles to the yield data. Since the yield data satisfy a reasonable test of fit the author concludes that "the yield per acre and the rainfall of the critical season are highly correlated; the rhythmical movements of the yield and of the effective rainfall may be accurately described by a compound cycle of 33 and 8 years with their semi-harmonics; and the yield curve reproduces the general characteristics of the curve of effective rainfall" (p. 55). This conclusion appears to be justified. It is an extension of the finding of Professor J. Warren Smith, Sectional Director of the U. S. Weather Bureau, who said in the 1903 Year Book of the Department of Agriculture: "If one knows the precipitation during the month of July over the great corn-producing district he can estimate the yield of the season very closely." Professor Smith's study, to which Professor Moore does not refer, covered the eight leading corn states for the period 1888-1902; average yield per acre was

compared graphically with the average precipitation in June, July, and August. In the Monthly Weather Bulletin for February, 1914, Professor Smith continued the study, this time using the Pearsonian coefficient of correlation. He found that for the eight states during the period 1888-1912 the yield of corn per acre and the rainfall in July gave a coefficient of 0.78. In an article on "Correlation of the Weather and the Crops" (*Journ. Roy. Stat. Soc.*, Vol. 70, pp. 5 *et seq.*), Mr. R. H. Hooker made a more refined study in which he measured the correlation between crops and (a) rainfall, and (b) accumulated temperatures above 42°, based on English data.

Demand curves for each of the four representative crops were found by correlating the percentage change in production each year in the United States, as compared with the production of the preceding year, with similar percentage changes in the prices per unit. The coefficients are, for corn, -0.789; for hay, -0.715; for oats, -0.722; for potatoes, -0.856. Parabolas of the third degree, $y=a+bx+cx^2+dx^3$, are fitted to the data, giving the laws of demand for each crop. The negative correlation coefficients indicate that the demand curves slope downward toward the right, so that "the amount demanded increases with a fall in price and diminishes with a rise in price." The reviewer has found similar demand curves to those found by Professor Moore. In contrast to agricultural products, the demand curve for pig-iron slopes upward toward the right; the correlation coefficient for percentage changes in production and in price being $+0.537$. The high negative coefficient found for each of the four crops proves that Mitchell was in error when he said: "The relations between physical production and pecuniary value are decidedly irregular with agricultural products." (Business Cycles, p. 239.)

But are price changes of each of the four crops in the United States as closely correlated (inversely) with changes in yield per acre as they are with changes in total production? They are; since the coefficients for price changes and changes in yield are, for corn, -0.815; for hay, -0.656; for oats, -0.718; for potatoes, -0.873.

The fluctuations in the yield per acre of the four representative crops in the United States correspond to the fluctuations in Illinois, the coefficients figured for annual differences ranging from 0.745 to 0.855.

But is the yield per acre of the four crops taken really representative of the yield of crops in general in the United States? Statistics of the yield per acre of nine crops are available for the period 1870-1911, including all the leading cereals, hay, potatoes, and cotton. Constructing a series of weighted index numbers of the yield of the nine crops and correlating with a similar series constructed for the four supposedly representative crops the extremely high coefficient resulting, 0.960, assures us that the four crops are really representative.

Professor Moore next considers the question of the association of the fluctuations in yield per acre of the nine crops and the fluctuations in the volume and activity of trade and industry. Pig-iron production and general wholesale prices (Aldrich and Labor Bureau series) are used as business barometers. Instead of using the annual figures of crop yield, iron produc-

tion, and general prices the author uses three-year averages, e. g., the crop yield for 1895 is the average for 1894–5–6, that for 1896 is the average for 1895–6–7, etc. After eliminating the linear secular trend in each of the three series of three-year averages he obtains "cycles" of yield, iron production, and prices. The differences between the original annual figures and the three-year averages for corresponding years are called "deviations." The deviations of yield and (1) of iron production and (2) of general prices are positively correlated to a moderate degree.

The vital question now at issue is this: are the crop yield cycles (as defined in the preceding paragraph) matched by similar cycles in iron production and general prices? If so, do the cycles come in concurrent years or is there a lag in iron production and prices? Computation of the coefficients of correlation gives the following table:

Cycles of yield per acre of	Lag of (1) and (2) behind crop yield.					
	Same year.	1 yr.	2 yr.	3 yr.	4 yr.	5 yr.
9 crops correlated with cycles of						
(1) Pig-iron production...........	0.625	0.719	0.718	0.697	0.572	....
(2) General prices................	....	....	....	0.786	0.800	0.710

The conclusions drawn by Moore from the table of coefficients are that cycles in crops precede cycles in pig-iron production by two years and cycles in general prices by four years.

The differences between the coefficients are not large enough to warrant a conclusion as to the number years of lag for maximum correlation. Computation of the coefficients of correlation between first differences of the cycles would be, however, a test of greater significance. The radical drop of pig-iron production in a year of depression, as compared with the drop in prices on crops, and the averaging of non-homogenous years, *e.g.*, two years of great activity and one year of great depression (for instance 1906, 1907, 1908), makes a conclusion based on the size of the coefficients between three year averages of doubtful value. In correlating three-year averages instead of the annual figures Professor Moore is really measuring the cumulative effects of three years of good or bad crops on business conditions as represented by iron production and prices. The coefficients for the annual figures and for first differences would have been more interesting and significant.

Statisticians and economists are deeply indebted to Professor Moore for his fine work in developing the statistical complement of pure economics.

Colorado College. WARREN M. PERSONS.

Some Aspects of the Tariff Question. By Frank William Taussig, Ph. D., Litt. D. Harvard University Press, Cambridge, 1915. Pp. 365.

Professor Taussig begins his exposition with a brief but sufficient statement of the theory of international trade and tariff restrictions on such

trade, covering some fifty pages. In the first chapter is discussed the effect of protective duties upon imports and domestic prices. In the second, attention is given to the argument for *Protection to Young Industries.* The third is devoted to a study of *The Principle of Comparative Advantage.* These chapters constitute Part I. In the rest of the book are considered in detail some of the principal lines of industry around which the tariff controversy has raged and which illustrate principles set forth in the introductory chapters: in Part II, Sugar; in III, Iron and Steel; in IV, Textiles.

In discussing the tariff on sugar, something is said of the effect of the remission of duty on sugar from Hawaii, provided for in the reciprocity treaty of 1876. It is pointed out that most of the supply still had to be got from less favored producers; that the price, therefore, did not fall because of the remission; that the United States Treasury lost and the Hawaiian planters gained by the arrangement. They were, in effect, included within the fold of the American protective system. The revolution in Hawaii, leading eventually to annexation, is attributed in large part to the desire of Hawaiian sugar interests for a permanent favored place in the American market, a desire stimulated by their temporary loss of protection under the McKinley tariff law.

The case of Hawaii illustrates the way in which external conditions may cause rearrangement of industry in accordance with the familiar principle of comparative advantage. The favored position of Hawaiian sugar in the American market made sugar production a comparatively advantageous industry, and tended towards exclusive devotion to this industry and to the importation of goods formerly produced in the islands.

The differential in favor of Cuban sugar, we should expect to redound wholly to the benefit of the Cuban producers, were it not that this sugar, together with that from other favored sources, constitutes such a large proportion of the total consumption in the United States. Under existing circumstances, however, it is thought that the actual burden on consumers has come to be, in recent years, somewhat less than the maximum duty, though remaining somewhat higher than the duties levied on the sugar from Cuba.

The study of the iron and steel industry, in Part III, gives opportunity for some interesting observations regarding the kinds of production in which Americans appear to have a comparative advantage. For example, it is pointed out in relation to the cutlery trade, that some kinds of cutlery are steadily imported, while other kinds are not imported at all. The latter are those made in great quantities of a single pattern; and it is where automatic machinery, interchangeable parts, standard patterns and mass production are possible, that Americans excel. On the other hand, cutlery of the non-standardized sorts is imported even over high duties.

Unlike many who have delved no more conscientiously into the detailed facts of industry, Professor Taussig does not believe that the *free trade versus protection* controversy can be settled by inductive argument. General reasoning from simple premises must first be appealed to and will remain

of primary importance. In this, the conclusion of Mill and the classical economists, he is, in the reviewer's opinion, entirely right. But the inductive study which he presents, and for which his claims are thus sufficiently modest, is none the less of great value. It serves to illustrate concretely principles usually stated in the abstract. And for many minds it is calculated to give emphasis to those principles and to bring conviction of their truth.

HARRY GUNNISON BROWN.

University of Missouri.

A CORRECTION.

In my note on "Mechanical Devices in European Statistical Work," in the QUARTERLY PUBLICATIONS for June, I stated that certain tabulating machines referred to were of the "improved Hollerith type, printing automatically, both sub-totals and totals." The phrase "improved Hollerith type" was a free translation of "new Hollerith" in the German source. The rest of the description was an inference from the statement in the same source that the "old Hollerith" machines separately classified, "record by clock-dials and contain no provision for addition." I concluded from this (too hastily as it appears) that the new machines embodied the same improvements as those used in tabulating the thirteenth census of the United States (as indicated in footnote references). I wish to thank Mr. E. Davies of New York City, for the information that this inference was erroneous.

F. H. KNIGHT.

Cornell University.

FACTORS AFFECTING THE HEALTH OF GARMENT WORKERS.

The Eighth Report of the Henry Phipps Institute for the Study, Treatment and Prevention of Tuberculosis has just appeared. It is a monograph of one hundred and four pages on "Factors Affecting the Health of Garment Workers," written by H. R. M. Landis, M.D., and Janice S. Reed. It is the result of a study of nearly a thousand workers in the garment industry examined while at their work. In the study three distinct types are included, the modern standardized factory, the contracting factory, and the sweatshop. The study includes the condition of the factories, the racial characteristics of the workers together with their physical condition, and the effect of trade processes upon this condition. The home environment of the workers is included, and tuberculosis and fatigue are given particular attention. The study deserves the attention of anyone who is interested in the health conditions in this trade. In the Appendix, copies of the inquiry blanks are included. These have apparently been drawn up with great care and might well serve as a model for future investigations along similar lines.

W. B. B.

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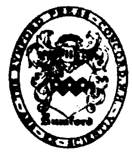
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AMERICAN
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NEW SERIES, No. 112. DECEMBER, 1915.

THE SERVICE OF STATISTICS IN PROBLEMS OF WAR AND PEACE.*

By E. Dana Durand.

The great war now tearing at the vitals of the world brings vividly before us the fact that the one most important political problem is the problem of war. Is war a good or an evil? Does war if successful pay the victor? Can war in any case be escaped? What are the real causes of war? What are its real effects?

These great problems have long been the subject of much discussion. In particular during the years just preceding the present war, a great deal of literature on the subject was evoked by the enormous expenditures of nations in preparation for war and by the obvious threat of the outbreak of hostilities. Some writers, like Bernhardi, glorified war as the duty of the superior race and as a benefit not merely to such race but to the world in general. Others, like Norman Angell, urged that war is an economic, social, and moral absurdity from which no nation and no class can gain. Most writers on the subject of war and peace, however, argued primarily on *a priori* grounds or made statements of fact without adequate proof. There is profound need of more detailed and more scientific inquiry. The economists, political scientists, and statisticians of the world ought to undertake a study of problems of war and peace on a larger scale and with greater thoroughness than they have hitherto done.

The present war will furnish a new mass of data for such an investigation. From no minor war could any such evidence be derived as to the effects of warfare upon the nations con-

* Address presented at special meeting of the American Statistical Association at San Francisco, August 11, 1915.

cerned and upon the rest of the world. Moreover, it is precisely this kind of gigantic conflict which must be anticipated from time to time in the future unless the world becomes convinced that warfare is unprofitable and succeeds in devising means of checking its recurrence. There is little chance that any two first rate powers in the future can resort to arms without bringing in other powers and initiating a world conflict.

A large proportion of the facts which should be known with reference to war and which bear on war problems are statistical facts. Many of the social and economic phenomena involved can be set forth only by statistics. The collection and analysis of data bearing upon the subject constitute an enormous field for the scientific statistician. If, as nearly all people hope, the United States can keep from being drawn into the present conflict, the American statistician will be peculiarly qualified to conduct statistical investigations regarding that conflict and its results. Free from the prejudice which can hardly fail to influence even the scientists of the warring nations, he should be able to present facts in their true light.

To mention some of the specific topics within this general field which lend themselves to statistical investigation is the object of this paper.

Most obvious, of course, is the topic of the economic cost and losses of war. So far as the direct costs are concerned, no great difficulty confronts the statistical investigator. He should readily be able to ascertain the direct expenditures of governments in preparation for war, in the actual conduct of war, in paying interest on war debts and in pensions. It would seem desirable to analyze data of expenditures in very considerable detail and to present also full information as to the sources of the funds expended. There would be much interest, also, in statistics as to the quantities of the various kinds of commodities and services used for military purposes and as to the sources whence the commodities were obtained—whether from previously accumulated stocks, from home production during the war, or by importation or capture.

The indirect costs of war furnish a more difficult field of inquiry. For instance, there is the question of the cost, under the system of compulsory military training, of taking

the young men of the nation for a period of years from the farm or the factory to the camp and the barrack. It may be, as contended by some, that the value of the military training in the life of men even in times of peace more than counterbalances the loss of time. This claim seems capable of investigation in some measure by statistical methods. One might compare the efficiency of the men of nations which have compulsory military service with that of the men of other nations, taking due account of differences in other conditions.

In the second place, in reckoning the cost of actual warfare the statistician might seek to compute the money value of the loss through the destruction of human lives and the maiming and invaliding of men. This is an economic loss quite aside from the pain and sorrow entailed.

Again, the statistician might seek to calculate the losses due to the destruction of non-military property and the disturbance of production and trade through war. Of course, one must not duplicate costs by adding to the expenditures of governments for the conduct of war, the amount by which the production of commodities not used for military purposes is reduced during the conflict. What happens in time of war is that a large part of the labor and capital of the country is turned from one occupation to another. People forego the production and consumption of certain kinds of goods in order to expend an equivalent amount of energy for military ends. But this very process of turning energy from one channel to another involves enormous friction and loss both during the war period itself and for a long time thereafter, and some measure of this is doubtless possible.

Especially great is the shock to business from a world war in these modern days when so much business is international in character. Before the present war broke out a large proportion of the products of each of the warring nations was being sold in other countries, great quantities in fact in countries now become enemies. International investment of capital had become of vast importance. A complex fabric of international exchange and credit had been built up. The business interests of each country were closely interwoven with those of other lands. This intricate business relationship of nations

has been torn asunder. Dealings between hostile countries have naturally ceased. Much of the business of the belligerents with neutral countries has been broken off or radically altered in character. The economic effects of the war have extended far beyond the boundaries of the fighting nations. This tremendous upheaval will leave its traces long after the war is over. The business relationships which formerly existed will not be readily renewed; in many cases the relationships of the future will permanently differ from those of the past.

To determine as far as possible the actual effects of the present war upon international business, to measure the nature, location, and extent of the losses involved and of the gains, if any there be, is a task largely within the province of the statistician.

Still another exceedingly important subject for investigation is the effect of war upon the distribution of wealth and income. Are the costs and losses fairly distributed among the people? The distribution of the burdens of taxation for war purposes, of the burdens of military service and of the indirect costs and losses of war should be considered. The relative effects upon different economic and social classes, upon different industries and occupations, should be measured so far as possible. Among the more specific problems in this field is that of the effect upon the different classes of people of the creation of a huge national debt. This subject has already been discussed with much acumen from an abstract standpoint, but more statistical facts concerning it should be sought.

The present war will afford important material for the study of vital statistics. Its effects upon the growth of population, both in the warring and in neutral countries, upon the marriage rate and the birth rate, upon migration, are bound to be marked. Still more interesting are questions as to the influence of war upon the physical, mental, and moral characteristics of the people. It has been urged that a great war, by killing off a large proportion of the stronger men, must cause a physical deterioration in succeeding generations. It has been suggested, too, that in the same way a deterioration of mental ability and even of morals may result from the decima-

tion of the population. The statistician can do something, at least, to test the validity of these opinions. Measurements and mental tests of children born during and after the war may be compared with those of children born during times of peace. Statistics of insanity and other congenital defects should be carefully studied at this particular time. Such investigations in vital statistics may throw new light upon laws of heredity and of human reproduction. It will be recalled that some have even argued that an increase in the relative number of male compared with female children results from the destruction of a large fraction of the adult men in a great war. The present conflict will furnish a test of this very doubtful view.

Such statistical studies of the effects of war as have been suggested—and these are by no means all that might be undertaken—would have not merely scientific interest; they might materially affect the future. The direction of this influence would of course depend upon the facts ascertained. Should it appear that the costs and losses of war are greater than ordinarily supposed, that those costs and losses are very unequally distributed among the people, and that serious injury results to the vitality of the nation, a general dissemination of these facts would surely cause rulers and people to be less ready to unsheathe the sword.

In quite another way, moreover, might the statistician affect the future of war and peace. He could throw more light upon the economic causes and motives of war. We need to know more, in the first place, as to the gains which a nation entering into any policy that tends to arouse international hostility may hope to attain by such policy. In the second place, we need more information as to the effect of the progress of one nation, particularly in its foreign trade, upon the prosperity of other nations. Finally, we need more light as to the economic advantages which a nation entering into war may expect to gain if it is victorious.

These three questions are intimately related. The same statistical investigations would go far toward answering them all. To illustrate this point it may be noted that it is not necessary to await the outcome of actual conflict in

order to form some judgment as to the possible gains of victory. For the economic objects which nations aim to secure by war are usually either precisely the same as, or more or less similar to, the objects which at other times they seek by less forceful means and which not infrequently one or another nation so obtains. Thus new colonial possessions, new spheres of influence in backward lands are sometimes gotten in peaceful ways, sometimes only by the sword. If the statistician can measure the gain from those acquired in the one way, we can forecast the gain from those acquired in the other. And by much the same process we can learn whether and how much rival powers are injured by such acquisition of territory or of spheres of influence.

That statistics have an important bearing in showing the wisdom or the folly of those nationalistic policies which tend to bring about war is evident from a mere enumeration of some such policies. For example, nations often seek the partial or complete exclusion of foreign goods, or seek to give their own citizens an advantage in international trade over competitors abroad. Import and export duties, laws for the direct exclusion of foreign products, bounties direct or disguised for home production or for exportation, are some of the measures by which these objects are sought. Other nations retaliate and the mere struggle of legislation and diplomacy may develop into armed conflict, or at least become a contributing cause of it. Other policies which often become a source of international friction are those with respect to shipping and other transportation agencies, to migration and the rights of foreign residents, to the investment of capital by foreigners, and especially to colonies and spheres of influence.

Regarding the effects of all economic policies of this character, much may be learned from statistics. Data as to the production of wealth in general and of particular kinds of wealth, as to the investment of capital, as to exports and imports, as to international exchange, as to currency and banking, as to prices and wages—all of these have their bearing on the wisdom or unwisdom of such policies.

It has been contended by many that, even if such policies

as have been mentioned did not involve the risk of drawing nations into war, they would still be economically unwise from the standpoint of the nation adopting them. We are told that it cannot pay a nation to adopt any line of conduct designed to give its citizens an advantage over those of other countries. Freedom for persons, for trade and for capital, parity between the citizen and the foreigner, are held to promote the wellbeing of a given country more than any form of discrimination. Others without such sweeping condemnation of all nationalistic policies maintain that at least this, that or the other such policy must fail to achieve the advantage sought. Against these stand many firm believers in the gains from nationalistic policies skilfully pursued. Much of the discussion pro and con has consisted of mere assertions or has rested on abstract reasoning alone. The true statistician, the honest and expert analyst of mass data, has indeed devoted no little study to the problems of nationalistic policy, but he has far from exhausted the field. In some directions there is still lack of statistical material which might without undue difficulty be secured. In other cases existing statistics are too inaccurate to furnish the basis for sound conclusions. But above all, the available statistics have not been adequately analyzed with a view to their bearing upon nationalistic policy. The statistician should seek greater influence in the shaping of legislation and administrative action regarding such matters as tariff, shipping, immigration, rights of foreigners and of foreign capital, colonies and spheres of influence. Not only would he thus aid the nation in the promotion of its true interests, but in all probability the wiser action which would result would remove much of the friction between nations and lessen the likelihood of war.

The assumption often underlying nationalistic policies is that the gain of one country must mean the loss of another. The people of England, for example, very generally believe that they have been injured by the industrial progress of Germany and the rapid increase of German exports. The majority of Germans believe that England's control of vast and populous dependencies has hampered the development

of German foreign trade. International jealousies based on such beliefs are important causes of war.

This underlying assumption of nationalism has recently been brilliantly attacked by Norman Angell and others, but it can not be said to have been subjected to the rigid test of scientific analysis. As has already been suggested, those statistical investigations which would help in the wise shaping of nationalistic measures or which would check their undue extension, would incidentally serve to test this assumption. And, in the same way, such statistical investigations would affect the allurement of victory, would lessen that allurement should the facts disclosed tend to show that the possible gains are less than ordinarily supposed.

We have thus far considered only the economic problems connected with war. Can the statistician go further and throw new light on those problems which are distinctly not economic in character?

We have heard much in recent years about the relation of nationality to war. Inherent national traits and peculiarities are held largely to explain all great conflicts. We are told by some that one of the chief causes of war is failure to give due recognition to the principle of nationality in fixing the boundaries of states. On the other hand, some give to nationality an even more threatening position as the disturber of peace. To establish each nationality as a self-governing state would in their opinion by no means cause wars to cease, but might even increase their frequency. They hold that often the inborn differences and antipathies between the peoples of different states are so great that they are sure from time to time to break forth into armed conflict.

Here again we are dealing too much with theory and bald assertion. We know too little about the facts of nationality. It is largely in statistics that we must seek more knowledge. The statistician may describe and weigh more accurately than has yet been done the characteristics of the several nationalities at the present time and the differences among them. Especially can he help us to judge to what extent the physical, mental and moral peculiarities of peoples are inborn and to what extent they are due merely to environment and

to historical accident. Men often speak glibly of the traits of the Teuton, the Celt, the Slav, or the Roman as being universal to all members of the group and as being unchanging. It may be so, but the assertion lacks proof. Compare, if you can, not the Teuton living in the north with the Roman living in the south, but the Teuton and the Roman living under similar conditions of soil and climate. Compare, if you can, not the Slav living amid the traditions of Russia with the Anglo-Saxon living amid the traditions of England, but the Slav and the Anglo-Saxon living in the same country under the same traditions. The United States offers a peculiarly favorable place for making such comparisons. We have assembled here representatives of every nationality. By the study of the nationalities in America the statistician and the sociologist can contribute much to science. Professor Boaz of Columbia University, as the result of interesting statistical measurements, has reached the conclusion that important physical changes take place with comparative rapidity among immigrant peoples after their arrival in the United States. If that is true it seems likely that mental and moral changes, changes in habits and ideals often supposed to be inborn, must likewise take place. Further statistical investigations along this line are clearly desirable.

If statistical study should perchance indicate that the extent and the permanence of the differences among nationalities have been exaggerated, this conclusion, when made widely known among the masses of mankind, would surely tend somewhat to lessen international antipathies. It has been the hope of pacificists that as, with increasing education and increasing intercourse, the people of one nation came to know more about their neighbors they would find more to like in them and less to dislike and fear. Even if, on the other hand, the statistician should ascertain that great and enduring differences do exist among nationalities, yet might his work serve somewhat to lessen the chances of war by leading nations to adopt policies, both internal and external, based on recognition of those differences.

Finally, the venturesome statistician may try his mettle on the problem of the moral consequences of preparation for

war and of war itself. Statistical data in this field must always be inadequate, but they may perhaps enable us to form some approximate judgment of the relative merit of the claim of the extreme militarists who maintain that war has an ennobling influence, and that of the extreme pacificists who hold that war is an injury to all the highest interests of mankind. The present struggle will furnish more material for such investigations than has hitherto been available to the scientific student.

It may be that some of the suggestions here presented as to the service of statisticians in solving problems connected with war are Utopian. Even as to much simpler matters it is hard to get sufficient and sufficiently accurate statistics and hard to draw certain conclusions even from satisfactory data. There are many factors in these problems which are not capable of statistical presentation. But public policy is being year by year more affected by the work of the statistician. He has already no little influence in matters relating to war and it is not too much to expect that deliberate efforts to increase that influence will prove well worth while.

SOME POPULATION STATISTICS OF THE PACIFIC COAST STATES.*

By Walter F. Willcox, Ph.D., LL.D., *Cornell University.*

During the last forty years of the nineteenth century the population of the United States grew at a rate which slowly but steadily decreased. This fact is obscured by the published figures for 1870, which are undoubtedly under the truth by some hundreds of thousands. If we accept as more accurate the revised figures for that year contained in the census of 1890 and later,† the rates of increase were as follows:

1860–70	26.6
1870–80	26.0
1880–90	24.9
1890–00	20.7

During the first seventy years of our national history no such steady change in the rate of increase was manifest and none such appears in European countries. On the contrary, during the last half of the nineteenth century the rate of growth in Europe as a whole apparently increased.‡ Still the uniformity of this change in the United States for thirty or forty years had led all students of population to expect its continuance into the twentieth century. Among the few who have made a serious effort to forecast the growth of American population, for a few years or a longer period, no one, I believe, anticipated that the rate of growth between 1900 and 1910 would exceed that between 1890 and 1900. Yet that is precisely what happened. The decennial increase instead of being less than 20.7 was 21.0, or 0.3 per cent. greater than in the earlier decade. Even 21.0 is too small, because the census of 1910 referred to April 15 as the determining date, while

*This paper was presented at the meeting of the American Statistical Association held with the University of California on August 12, 1915.

† Census of 1910, *Abstract*, p. 22. Elsewhere I have given my reasons for doubting the correctness of this revision. (See Am. Econ. Assn., *Studies*, August, 1897, p. 348). I do not believe that the rate of increase during the decade including the Civil War was greater than the rate during the succeeding decade. But for the present argument that question is of little importance.

‡ "The Expansion of Europe" (p. 46) in *Studies in Philosophy and Psychology*, Houghton, Mifflin & Co. 1906.

that of 1900 referred to June 1 and, in consequence, the interval between the two censuses was only $9\frac{7}{8}$ years. When allowance for this change is made, the rate of decennial increase proves to have been 21.3, or 0.6 per cent. greater than during the preceding decade. This unexpected change in the rate of population growth tends to discredit all forecasts of our future population which assume that the increase follows any definite law.

To get some light upon this noteworthy modification in the growth of population, we may ask whether what was true of the whole country was true of the parts. For statistical purposes the country is divided into three main areas, the northern states, the southern states and the western states. The division line between north and south is Mason and Dixon's line, the Ohio, and the southern boundary of Missouri and Kansas; the division between these two and the western states is the western boundary of the Dakotas, Nebraska, Kansas, Oklahoma, and Texas. The percentage of increase of each of these three divisions for each of the decennial periods is shown in the following table:

PER CENT. INCREASE OF POPULATION.

Division.	1860–70.	1870–80.	1880–90.	1890–1900.	1900–10.
North	27.6	26.9	24.9	19.0	17.7
South	21.9	21.7	21.3	22.4	19.8
West	80.1	58.5	75.5	31.9	66.7

The preceding figures show that the rate of growth of the northern states as a whole fell steadily throughout the half century. The rate of growth of the southern states has changed irregularly and very slightly, its total fall being little more than one fifth of that in the North. Perhaps there was an undercount in the southern states in 1890 as well as in 1870; at least various bits of evidence suggest that as a possibility. The figures show also that since 1890 the southern states have grown faster than the northern. The western states have had high and very irregular rates of growth, with a minimum during the last decade of the nineteenth century and a sharp increase ten years later.

This analysis indicates that between 1900 and 1910 the rates of increase in North and South, just as might have been expected, were less rapid than in any previous decade. It shows also that the unforeseen rise in the rate of growth of the United States in those ten years was due entirely to the fact that in the later decade the West increased more than twice as fast as in the earlier. The increase in the West raised the average for the whole country between 1890 and 1900 by 0.6 per cent. and between 1900 and 1910 by 2.6 per cent. In other words, the greater population and the higher rate of increase in the West in combination gave it more than four times the influence upon the entire country between 1900 and 1910 that it had ten years earlier.

When the West is divided into its two main components, the Pacific states, Washington, Oregon and California, and the Mountain states, and the figures found for each, the rate of growth in the Pacific states proves to have been higher between 1900 and 1910 than in any of the preceding four decades and for the first time higher than that of the Mountain states.

The striking increase in the rate of growth of the country as a whole, of the western division and especially of the Pacific Coast states since 1900, is one of the most noteworthy results and perhaps the most unexpected result of the Thirteenth Census. The general reasons for it are doubtless better known to residents of these states than they can be to one who now sees the West for the first time. Most of them also are incapable of detection or measurement by statistics and with such I have little concern. The general question which I hope to elucidate with certain figures is: "Why have the Pacific Coast states grown so rapidly since 1900?" the special question to which this paper is limited is: "What light do statistics throw upon the sources and character of that increase and the probability of its continuance?"

In the world as a whole an increase of population results from an excess of births over deaths and in no other way. But in any particular area of the earth's surface, like the United States or the Pacific Coast states, such an increase may result either from an excess of births over deaths (natural increase)

or from an excess of immigrants over emigrants (migratory increase). Usually, however, it is a resultant of these two forms.

This distinction between natural increase and migratory increase raises the question, "Is the recent growth of the Pacific Coast states due to either alone or to a combination of the two and, if to a combination, then what proportion of it is due to each source?"

For the direct study of migratory increase, there are no complete records of arrivals in or departures from these states. Immigrants arriving at the Pacific ports of the United States are registered, but how long they remain in the Pacific states and by what routes they depart, if they depart at all, are unknown elements of the problem. Arrivals by sea constitute probably a small fraction of the total arrivals. Those arriving by land come in part across the northern and southern boundaries of the country, but more largely from or through the easterly states. For this branch of the inquiry, then, no significant figures exist and we are compelled to content ourselves with the meager results which can be reached indirectly from a study of the census figures of birthplace and residence, to which I shall return.

For the direct study of natural increase the conditions look more favorable. Since 1906 California has had a state system of registering births and deaths and since 1908 Washington has had a similar system of registering deaths. Oregon has not yet introduced state registration in either form, but it would seem as if indications at least might be derived from the records of the other two states. Certainly the material deserves to be probed before accepting or rejecting it.

I begin with California where the records have existed longer than in Washington and include births as well as deaths. They have shown the following results:

BIRTHS AND DEATHS IN CALIFORNIA, 1906-1914.

Year.	Births.	Deaths.	Excess of Births.	Excess of Deaths.	Birth Rate.	Death Rate.
1906	20,974	29,303		8,329	10.3	14.1
1907	24,674	31,095		6,421	11.6	14.6
1908	28,077	31,287		3,210	12.7	14.1
1909	30,828	30,985		157	13.4	13.4
1910	32,138	32,398		260	13.4	13.6
1911	34,828	34,012	816		14.0	13.7
1912	39,330	36,709	2,621		15.2	14.2
1913	43,852	38,599	5,253		16.4	14.4
1914	46,012	37,537	8,475		16.7	13.4

In eight years the births recorded have more than doubled, while the deaths have increased only 28 per cent. The increase in the births must be due mainly to the growing completeness of registration. This is shown by the fact that even now the birth rate of the state is incredibly low. Probably the true birth rate in California is not below that in France or Ireland. If so, 20 births a year to each 1,000 population may safely be assumed as a minimum. But the rate resulting from the figures of 1914 is only 16.7, or five sixths of a rate of 20 per 1,000. Again, the number of children under one year of age living in the state at any one moment must be approximately equal to the number of births in the preceding year diminished by the number out of this group who died before the day of enumeration was reached. The number of infants under one year of age enumerated in California April 15, 1910, was 40,336; if we assume that this number is not more than nine tenths of the number of births during the preceding year, the true number of births in California between April 15, 1909, and April 15, 1910, was not less than 45,000. But the number recorded in 1909 was 30,828, and in 1910 32,138, an annual average of 31,500. This estimate indicates that in 1909–10 not more than seven tenths of the births in California were registered. Certainly not all the births and probably not more than five sixths of them are now registered. Washington has no significant state records of births. Hence none of the three states has trustworthy birth rate figures, a defect which they share with the majority of other American states.

In case of a death, the body must be so bestowed as to reduce the chance that legal complications will arise or the health of survivors be endangered. Hence ordinarily records of deaths are more complete than those of births. Are the death records of California and Washington helpful in our problem? The death rates for the two states since their beginning are as follows:

Year.	Death rate of California.	Death rate of Washington.
1906	14.1	?
1907	14.6	?
1908	14.1	9.3
1909	13.4	9.8
1910	13.5	10.0
1911	13.7	8.9
1912	14.2	7.9
1913	14.4	8.5

It will be noticed that between 1909 and 1913 the death rate of California rose slowly but steadily. This is no evidence of an actual increase of mortality and thus of a deterioration in the conditions within the state. It is rather a change in which all citizens of California may take pride as evidence that by coöperation of state and local authorities an increasing proportion of all the deaths which occur in the state were recorded.

The death rates of California and Colorado since 1906 show an interesting contrast.

Year.	Death rate of California.	Death rate of Washington.
1906	14.1	14.0
1907	14.6	15.3
1908	14.1	14.5
1909	13.4	14.2
1910	13.5	13.8
1911	13.7	12.9
1912	14.2	11.6
1913	14.5	11.5

Since 1909 the death rate of California has been rising, while since 1907 that of Colorado has been falling. It might seem as if Colorado had been growing more healthful and California, less healthful. But the probable meaning of the figures is that Colorado has been growing more careless and California more careful in securing the registration of all deaths occurring within its limits. A death rate of 11.5 for a state like Colorado is highly improbable. No doubt many deaths escape registration or the population of the state is greatly overestimated or both. In order to avoid the complication of estimating population for an intercensal period in regions where the rate of growth is subject to sudden and violent fluctuations and the estimates therefore are likely to be very wide of the truth, and to allow for accidental variations in a single year, let us confine ourselves to the death rates for the three year period 1909–11. As the difficulties in the way of complete registration are much greater in sparsely settled districts than in cities, the effort to judge from internal evidence whether the records of deaths in California during those years were complete has been confined to the rural districts excluding all incorporated places having at least 8,000 or 10,000 inhabitants. An average death rate of less than 12 in these districts is so low as to arouse suspicion that not all the deaths are registered. An average death rate of less than 10 is so low as to make the suspicion almost a certainty.

In the following table the counties of California have been divided into three classes: those having a death rate below 10 per 1,000 in the rural districts and no doubt with incomplete registration; those with rates between 10 and 12 in their rural districts and probably with incomplete registration; and those with rates above 12 and thus perhaps not intrinsically improbable.

AVERAGE DEATH RATES IN RURAL PORTIONS OF CALIFORNIA COUNTIES, 1909-11.

Under 10.		10-12.		Over 12.	
County.	Death Rate.	County.	Death Rate.	County.	Death Rate.
Mono	3.3	San Mateo	10.2	Monterey	12.0
Inyo	4.4	Fresno	10.4	Calaveras	12.3
Modoc	5.7	Marin	10.5	Colusa	12.4
Lassen	6.0	Contra Costa	10.6	Ventura	12.5
Imperial	6.7	Plumas	10.7	Placer	12.8
Glenn	7.0	Kings	10.9	Santa Cruz	13.0
Del Norte	8.2	San Luis Obispo	11.0	Los Angeles	13.2
Humboldt	8.2	Riverside	11.1	Sonoma	13.4
San Diego	8.2	San Benito	11.3	Mendocino	13.6
Merced	8.3	Solano	11.6	Tuolumne	13.6
Alpine	8.5	Orange	11.7	Shasta	13.9
Kern	8.9			Yolo	13.9
Sierra	8.9			Lake	14.2
Tulare	9.0			Amador	14.3
Mariposa	9.1			Trinity	14.5
Madera	9.2			Butte	14.8
Santa Barbara	9.6			Tehama	14.8
Sutter	9.7			Nevada	15.1
Siskiyou	9.8			Santa Clara	15.1
Stanislaus	9.8			San Bernardino	15.3
				Yuba	15.8
				San Joaquin	15.9
				Eldorado	16.3
				Sacramento	16.3
				Alameda	16.6
				Napa	25.4

In more than one half of the counties in California the published death rate for the rural districts is improbable and in many it is impossible.

In Washington the death rate in 1913 was only 8.5, nearly 2 per 1,000 below that in any other state. In 1906, South Dakota was admitted to the federal registration area and its death records accepted by the Census Bureau as approximately correct. Through 4 years it retained that position and its death rate was.

DEATH RATE IN SOUTH DAKOTA.

Year.	Ratio per 1,000.
1906	8.5
1907	9.1
1908	9.2
1909	8.5

After these 4 years the state was excluded from the registration area because of incomplete returns. The state of Washington now holds the unenviable position formerly occupied

by South Dakota. It might be wise for the Director of the Census to treat the Pacific Coast state in the same way in which South Dakota was treated six years ago. The inclusion of incorrect and misleading returns along with those which are significant tends to discredit the whole set of federal figures and to the uninformed suggests the unwarranted inference that Washington is far healthier than any of the 22 other states in the registration area.

But if the registration officials in the state of Washington were ready and eager to coöperate with the federal government, perhaps a compromise might be arranged whereby the state figures would be retained provisionally and so long as each annual death rate was higher than its predecessor, just as that of California has been for five years. In any state and especially in a sparsely settled state like Washington, the task of building up a system of death registration is long and difficult, and, if the process is really under way as proved by the results, I believe the Director of the Census should not exercise his discretionary power to exclude a state from the registration area.

The evidence, then, warrants the conclusion that the death records of Washington and the birth records, if not the death records, of California are very imperfect and as a result cannot serve as a basis for studying the recent growth of population in the Pacific states.

Thus far my conclusion has been the negative one that no significant materials exist for a direct study of the increase of population in the Pacific Coast states whether by excess of births over deaths or by excess of immigrants over emigrants or both.

In both fields, however, a substitute for registration figures, though only an inadequate one, exists in the census records of birthplace or of sex and age and an examination of these is now in order.

Persons living in the Pacific states grouped by birthplace are of three main classes, those born in foreign countries, those born in the Pacific states and those born in other parts of continental United States. To these should be added as a small residual class those whose birthplace was not stated,

those who were born in the United States but with state of birth unknown, those born abroad under the American flag, and those born in outlying districts of the United States, like Alaska, Hawaii, Guam, Samoa, and the Philippines. All these classes combined constituted in 1910 about 1 per cent. of the population of the Pacific states. In the following analysis they will be disregarded.

Consider first the foreign born, or immigrant population, as a whole. The increase of population in the Pacific states between 1900 and 1910 was more than 1,750,000, more than three times the amount and at more than double the rate of increase in the preceding ten years. During the same period the increase of foreign born was more than 400,000, twelve times the increase of foreign born in the preceding ten years. Of the total increase, 1900–1910, nearly one fourth (23.3 per cent.) was an increase of the foreign born population, while in the earlier decade only one seventeenth (5.8 per cent.) was due to this current. This does not prove that the number of foreign born had increased faster than the number of American born. On the contrary, the two classes increased at about the same rate. But in the decade between 1890 and 1900 immigration to these states from foreign countries had almost ceased. In that decade the number of foreign born increased only 6 per cent., while in each of the other four decades it increased by at least one half.

An introductory survey of the main birthplace classes in the population of the Pacific states at each of the last five censuses can be obtained from the following brief table.

PERCENTAGE DISTRIBUTION OF POPULATION OF PACIFIC COAST STATES, ACCORDING TO BIRTHPLACE.

Place of Birth.	1870.	1880.	1890.	1900.	1910.
Pacific states	32.8	38.9	36.6	42.4	35.8
Other continental United States	33.7	30.7	35.9	34.8	40.4
Outlying districts or unspecified			0.1	0.3	1.0
Foreign born	33.5	30.4	27.4	22.5	22.8
Total†	100.0	100.0	100.0	100.0	100.0

This shows that between 1870 and 1900 the proportion of foreign born in the population decreased from one third to little

more than one fifth, but during the following decade it remained substantially unchanged. The outstanding fact revealed by the table is the great increase between 1900 and 1910 in the proportion of the population of the Pacific states drawn from other parts of the country. In other words, the population of the Pacific states has grown so rapidly since 1900 because natives of other sections of the United States have been flocking westward. There has been no corresponding increase in the natives of the Pacific states. As a recently opened region fills with population the proportion of natives usually tends to rise and the proportion of immigrants to fall. In the preceding table the natives of the Pacific states in 1870 were less than one third, and in 1900 were more than two fifths of the population. By 1910 the proportion had sunk below what it was in 1880, 1890, or 1900. The foreign born fall into two groups styled by the census "white" and "colored." The term "colored" is used as a convenient generic term to include all racial elements other than the European whites. It embraces Negroes, Indians, Malays, Chinese, and Japanese. Whether this is good ethnology may fairly be questioned. But good ethnology is hardly to be reconciled with the requirement that its tests should be understood and, when necessary, applied by an army of more than 70,000 enumerators.

In the Pacific states the only numerous components of the foreign born colored are the Chinese and Japanese. In these states in 1910 there were 94,000 foreign born colored and 104,000 Chinese and Japanese. The excess of 10,000 Chinese and Japanese over all foreign born colored is due to the fact that thousands of the former claimed, some no doubt wrongly, to have been born in the United States. In the entire country there were nearly 20,000 Chinese and Japanese who claimed to have been born in the United States. The majority were probably residing in the Pacific states, where both elements have been domiciled for the longest time. The foreign born colored in the Pacific states decreased by 14,000 between 1890 and 1900 and increased by 22,000 between 1900 and 1910, a total increase of 8,000 in twenty years. During the same twenty years the foreign born whites increased by more than 400,000. As a result the foreign born colored are

a dwindling proportion of the total foreign born. In 1890, they were 16.7 per cent., in 1900, 13.2 per cent., and in 1910, 9.9 per cent. of the foreign born. Because of this relative decrease in the foreign born colored the proportion of whites in the total population of the Pacific states has been rising:

Date.	Per Cent White.
1860	87.0
1870	90.1
1880	89.5
1890	92.9
1900	94.9
1910	96.0

The tendency towards an increasing predominance of whites in the total population appears in the whole United States as well as in the Pacific states, but in the latter the increase since 1860 has been 9.0 per cent., while in the whole country it has been only 3.3 per cent., or little more than one third as great.

A rough estimate of the number of foreign born who arrived in the Pacific states between 1900 and 1910 may be reached by starting with the number of foreign born residing in the Pacific states in 1900 and subtracting the probable number who died before 1910. This number of deaths has been estimated by applying to the foreign born in the Pacific states the death rate of the foreign born whites in the registration area in 1900. The group was probably reduced between 1900 and 1910 by about 92,750 deaths, leaving, if emigration be ignored, about 451,600 survivors in 1910 of the foreign born who had been in the Pacific states in 1900. If this number be subtracted from the total foreign born in these states in 1910, it leaves 504,200 as the number of survivors in 1910 from the foreign born who had arrived in these states during the preceding decade. Assuming that they had been in these states on the average five years, the number of arrivals needed to produce this number of survivors was about 553,500. That this number exceeds by 235,000 the number of foreign born in the Pacific states who had been in the United States less than ten years may be explained by the fact that many foreign born who had

arrived in the United States before 1900 and had been gradually advancing across the continent reached the Pacific states after 1900.

Consider now the increase in immigrants coming from other sections of the United States or more accurately the increase in natives of other sections residing in the Pacific states. The total population increased 74 per cent.; the foreign born, 76 per cent.; those born and residing in the Pacific states increased only 46 per cent.; but the natives of other states residing in the Pacific states increased 105 per cent. Obviously the Pacific states since 1900 have recruited their numbers primarily from the natives of other states and least of all from their own loins. The immigration of natives from other states as roughly measured by these birthplace figures more than doubled during the decade. The heaviest contributions came from the Mississippi Valley states, Illinois, Missouri, and Iowa, but the most rapid increase in the flow between 1900 and 1910 was from the states farther west and the slowest increase from the states farther east and especially from New England. In order to define the contributory area more accurately I have prepared the accompanying table, showing the number of natives of each state east of them living in the Pacific states in 1900 and in 1910 with the per cent. of increase during the decade.

In the following table, Oklahoma, Florida, and Nevada are exceptional. The population residing in Oklahoma more than doubled and that born in Oklahoma increased 160 per cent. between 1900 and 1910. Probably, also, the average age of the natives of the state increased, as the average age of its residents certainly did, and as a rule migration is more common in adult life. The increased migration from Florida to the Pacific states is probably connected with the similarity of agricultural conditions in Florida and southern California, and the great prosperity of sub-tropical agriculture in California since 1900. This explanation is made more probable by the fact that the increase has gone mainly to California rather than to Oregon or Washington. Nevada shows a small increase because the emigration from that state in the years before 1900 had been abnormal.

NATIVES OF STATE SPECIFIED RESIDING IN PACIFIC STATES, 1900 AND 1910, WITH PER CENT. OF INCREASE.

State.	Number.		Per Cent. Increase.
	1900.	1910.	
Oklahoma	1,061	10,695	908.0
Colorado	6,994	26,429	277.9
North Dakota	3,939	13,691	247.5
Montana	4,035	13,762	241.6
Florida	665	2,102	216.1
South Dakota	5,199	16,376	215.0
New Mexico	1,198	3,669	206.3
Arizona	2,498	7,369	195.0
Minnesota	30,860	88,069	185.4
Idaho	5,245	14,941	184.9
West Virginia	3,962	11,143	181.2
Wyoming	1,367	3,590	162.6
Michigan	33,945	87,523	157.8
Nebraska	19,333	48,583	151.3
Texas	12,425	30,977	149.3
Georgia	3,705	9,174	147.6
Wisconsin	38,348	94,035	145.2
Utah	4,606	11,264	144.5
Kansas	33,238	75,238	126.4
North Carolina	5,456	12,205	123.7
Alabama	3,190	7,029	120.4
Arkansas	7,985	17,546	119.7
Mississippi	2,859	6,019	110.5
Iowa	62,534	131,064	109.6
Kentucky	17,228	35,456	105.9
U. S. outside of Pacific states	*824,372*	*1,691,505*	*105.2*
Illinois	81,838	166,396	103.3
Indiana	39,398	79,938	102.9
Louisiana	4,172	8,282	98.5
Tennessee	14,543	28,726	97.6
Pennsylvania	46,135	90,952	97.1
South Carolina	1,542	2,955	91.7
Missouri	69,160	131,907	90.7
Ohio	64,754	119,007	83.8
New Jersey	7,748	14,012	80.8
Delaware	966	1,701	76.1
Virginia	11,520	19,183	66.5
Connecticut	6,471	10,748	66.1
Rhode Island	2,577	4,071	58.0
District of Columbia	1,430	2,230	55.9
Maryland	5,632	8,770	55.7
Massachusetts	25,334	38,844	53.3
New York	83,562	127,813	52.9
New Hampshire	5,235	7,059	34.9
Vermont	9,001	12,027	33.6
Nevada	8,648	11,427	32.1
Maine	22,731	27,508	21.0

If the emigration of native Americans to the Pacific Coast states is analyzed with due regard to the populousness of the contributing states and the proportion of the natives of each state who were living in the Pacific Coast states to the total natives of the state living in the United States, it appears that the smallest contributions, less than 1 per cent. of the total natives, came from the southeastern states, New Jersey to Arizona inclusive in 1900 and New Jersey to Louisiana in 1910;

that the states contributing 1 to 3 per cent. of their natives in 1900 were northern states from Maine to South Dakota (with Utah), and in 1910 were a belt of states stretching across the country from New Hampshire to New Mexico; and that the states contributing more than 3 per cent. of their natives were the northern and western states from Iowa to Arizona (1900) or Michigan to Arizona (1910).

Consider now the increase between 1900 and 1910 in the natives of the Pacific states living in these states. This number rose by only 46.4 per cent., a ratio much less than the increase in any other of the population groups. This slow increase suggests either that the true death rate in the Pacific states is high, and this is not borne out by any evidence at hand, or that the true birth rate is abnormally low, and this is in harmony with what we know from other sources. To my mind, the best single substitute which the data allow for an American birth rate is the proportion of children under five years of age to the number of potential mothers, or women of age to bear children, an age which is roughly defined as 15 to 44 or 15 to 49, sometimes one group and sometimes the other being available. In the United States as a whole in 1910 there were 446 children under 5 to 1,000 women 15 to 49 years of age, and for half a century this proportion had steadily and rapidly decreased. If we divide the United States into the three parts, Pacific, Mountain, and rest of the United States, the proportions of children to 1,000 women in 1910 were as follows:

Division.	Children under 5 to 1,000 Women 15–49.	Per Cent. Deviation from Average.
Pacific	343	−23
Mountain	488	+10
Rest of United States	449	+ 1
Total	446	0

The proportion of children in the Pacific states is 23 per cent. below the average for the country, which may be taken as the normal, and 30 per cent. below that in the Mountain states, next east of this area. The conclusion that the Pacific states are characterized by an extremely low birth rate is an unavoid-

able one. The following figures show that the birth rate as thus measured has been steadily falling for half a century and is now less than half (44.5 per cent.) of what it was in 1860.

Date.	Children to 1,000 Women 15-49 Years of Age in Pacific Coast States.
1860	771
1870	653
1880	541
1890	424
1900	379
1910	343

On the whole, the evidence indicates that the astonishing increase of population in these states since 1900 has been mainly due to immigration in some degree from abroad, but especially from other states, and slightly due to excess of births over deaths. Increase as a permanent and normal social process usually depends primarily upon natural increase and a growth of population resulting mainly or entirely from immigration has a weaker guarantee of permanence, While the evidence in hand does not warrant a definite answer, it does point to a slackening in the growth of population of the Pacific states as likely to occur in the near future.

"ON THE HANDICAPPING OF THE FIRST BORN," A CRITICISM OF PROFESSOR PEARSON'S 1914 MEMOIR.*

By Louis I. Dublin, *Statistician,* and Harry Langman, *Statistical Bureau, Metropolitan Life Insurance Company, New York.*

In his paper "A First Study of the Statistics of Pulmonary Tuberculosis,"† 1907, Professor Pearson concluded among other things that the early born, particularly the first, are more liable to develop tuberculosis than are the later born. This finding of Pearson's was severely criticized by a number of workers, but especially by Yule and Greenwood,‡ Weinberg§ and Macaulay.|| In his more recent memoir, "On the Handicapping of the First Born," 1914, Professor Pearson elaborates this thesis and responds to the criticism directed at his first paper.

In his 1907 paper, Pearson classified the 381 patients of a tuberculosis sanatorium by order of birth. He also arranged the sibships, i. e. the group composed of the 381 tuberculous persons and their brothers and sisters, in a similar order. He then assumed that, in principle, these two distributions by order of birth should be identical, supposing that the distribution of the sibships is equivalent to the distribution by order of birth of the tuberculous population at large. He found actually that the first and second born among the patients were represented considerably above the number expected from the distribution of the sibships. He concluded, therefore, that the early born are more liable to tuberculosis.

It is this assumption of the identity of the two distributions

* Eugenics Lecture Series. X. Dulau and Company, London.

† Studies in National Deterioration, Drapers' Company Research Memoirs. Dulau and Company, London.

‡ On the Determination of the Size of Family and of the Distribution of Characters in Order of Birth from Samples taken through Members of the Sibships. Journal of the Royal Statistical Society, Vol. LXXVII, 1913–1914.

§ "Die rassenhygienische Bedeutung der Fruchtbarkeit" Arch. f. Rassen- u. Gesellschafts-Biologie, 1910 Vol. VII, p. 684. "Zur Frage der Messung der Fruchtbarkeit," *Ibid.*, 1913. Vol. X, p. 162.

|| The Supposed Inferiority of First and Second Born Members of Families—Statistical Fallacies. 1912. T. B. Macaulay, Montreal, Can.

that is the basis of much of the criticism. We shall also address ourselves to this matter below. In addition other more general criticisms have been made, especially by Macaulay, which indicate why we may expect the early born to be represented in larger proportions without involving Pearson's conclusion. They, the early born, have had a greater opportunity to pass through the so-called "danger zone" and to become patients of tuberculosis sanatoria; younger brothers and sisters may well have a pronounced tubercular diathesis, but because of their youth may not as yet have developed the disease sufficiently to need sanatorium care. There is also a tendency, even if not a very pronounced one, in tuberculous stocks for the undue representation of early borns; for the number of offspring in the family is likely to be cut down below the average through the early death of tuberculous parents, or through other circumstances which commonly break up family ties in tuberculous stock.

Pearson, in his second paper, virtually waives the above objections. He proceeds rather, at great pains, to substantiate the other assumption which was involved in his first paper, and which was criticized rather severely by Yule and Greenwood, namely, that the distribution of the sibships by order of birth is equivalent to the distribution of the tuberculous population at large. For, if this assumption is invalid, the two distributions referred to above are not comparable, and no valid conclusions can be drawn from any such comparison. In his reply, the author does not mathematically establish his conclusion as to the identity of the two distributions. He explains that he has considered the distributions of the affected in a number of cases where the distributions of the pathologic communities from which they were chosen were approximately known, and has compared the latter distributions with those obtained from the distributions of the affected by various methods, including those of his critics. On the basis of this comparison, the author has satisfied himself that the distribution of the sibships of the affected is in general the best representation of that of the pathologic community at large.

The author then extends his argument by introducing a

discussion of the mortality and "delicacy" rates of infants by order of birth. He also considers various indications of degeneracy in families by order of birth, including such traits as imbecility, epilepsy, insanity, albinism, criminality, tuberculosis, and congenital cataract. Using the same methods as have already been described for tuberculosis, he finds a marked weighting of the first born in all these defects, except in epilepsy.

After summing up his data, the author comes to the definite conclusion that "the small family is detrimental to race progress." This conclusion he makes without reservation; for such families are constituted to a greater degree by the early born who, as he maintains, are more often defective.

For the sake of the argument let us assume that the author's tables actually show what he claims for them. Then all that follows is that the early born of the community are more likely to be inferior than the later born. It does not follow, as Pearson infers, that the early born are necessarily inferior to other siblings of their own families. Nor is it true for the pathologic community at large, since the author's subjects, taken from institutions, are distributed mostly between certain ages. Thus, what may be true of patients in a tuberculosis sanatorium need by no means be true of tuberculous persons in general, who include many children, and these are rarely found in sanatoria. Especially in the face of evidence of inferiority of the last born, it is not safe to assume that superior individuals would be obtained by increasing the size of the families in question. As has already been pointed out, this inferiority of the early born may be due to an undue representation of small degenerate families; or it may be due to the higher average age of the elder born, the younger born not having as yet attained an age at which criminal or pathologic tendencies will have had opportunity for expression to a like degree; or to such circumstances as economic pressure upon older children, or to other external conditions, and not simply to the physiologic fact of being elder born.

Thus far we have assumed that Professor Pearson's method of procedure is valid. His method is based unequivocally on the assumption that the distribution according to order of

birth of the pathologic community from which his "marked" or affected subjects are obtained is identical with the distribution of the sibships of these subjects. For if that be the case he can use the distribution of the sibships of the affected as a norm in comparing with it the distribution of the affected, in the effort to show that actually the early born among his subjects preponderate beyond all expected proportions. We shall endeavor to show that, when there is no weighting according to order of birth among the individuals affected, the distribution of the affected or that of the pathologic community represented by them is not in any case comparable with that of their sibships. We propose to take the distribution of a normal population, and, supposing all members of it to be liable to some disease in equal proportions, obtain from it the distribution of the sibships of the affected by order of birth which is to be expected on the assumption made. We shall find that the distribution of the sibships is by necessity so different as to account for practically the whole difference found by Pearson. To illustrate our point, we submit the following table:

TABLE I

RECONSTRUCTION OF THE DISTRIBUTION, BY ORDER OF BIRTH, OF THE SIBSHIPS OF THE AFFECTED FROM THAT OF THE AFFECTED, OR FROM THAT OF THE GENERAL PATHOLOGIC COMMUNITY.

Sibling's Order. / Number in Family.	Industrial Classes, N. S. W.	Number of Families with 1, 2, or More in Family.	Individuals in Families of Respective Order.	Distribution of Sibships of Affected.	Per Mille Distribution of Affected.	Per Mille Distribution of Sibships of Affected.
	I	II	III	IV	V	VI
1	7,670	667	667	46,325	165.57	124.68
2	7.003	819	1,638	45,658	151.17	122.88
3	6,184	742	2,226	44,020	133.49	118.48
4	5,442	734	2,936	41,794	117.47	112.48
5	4,708	722	3,610	38,858	101.63	104.58
6	3,986	720	4,320	35,248	86.04	94.87
7	3,266	673	4,711	30,928	70.50	83.24
8	2,593	666	5,328	26,217	55.97	70.56
9	1,927	522	4,698	20,889	41.60	56.22
10	1,405	497	4,970	16,191	30.33	43.58
11	908	362	3,982	11,221	19.60	30.20
12	546	235	2,820	7,239	11.79	19.48
13	311	144	1,872	4,419	6.71	11.89
14	167	167	2,547	2,547	8.12	6.85
Over 14	209					
Total	46,325	7,670	46,325	371,554	1000	1000

In the foregoing table we give in Column I the distribution, by order of their birth, of the siblings of a community of 7,670 fertile families taken from the industrial class in New South Wales, as quoted in Pearson's paper on pulmonary tuberculosis. We suppose, also, that all of these siblings are equally liable to some disease irrespective of their order of birth. On this assumption, we shall obtain (Column VI) the distribution of the sibships of the affected which are to be expected from the distribution in Column I. From Column I we first obtain Column II, the distribution of the families in the community according to size. From Column I we have, for instance, 4,708 fifth born and 5,442 fourth born. But we must have a fourth born for every fifth born, and any excess of the former must therefore be due to families of four only, in this case 734 in Column II. In similar manner we obtain each of the other figures in Column II. Now we have, for instance, 734 families of four each. Then we have 2,936 individuals (Column III) all belonging to families of size four. Thus we obtain for Column III a distribution of the siblings of our population classified according to size of family to which they belong. Since we have assumed all these siblings equally liable to a disease, the figures of Column III must give, in their proportions, the distribution of the affected as well, according to size of family to which they belong.

We must realize now that the subjects under Professor Pearson's consideration (distributed as in Column III) are all included in the same institution. These subjects were presumably drawn at random from the pathologic community at large. We inquire now as to the probable number of families of the community we are considering that have more than one representative among the inmates of the institution. The probability of a particular member of the community being an inmate of the institution at any given time is small. The likelihood that two members of the same family are represented among our subjects is then extremely small, for, in the first place, both must be diseased; further, both must have the disease developed to the stage where they need institutional care; both must be sent to some institution; of all institutions, both must be committed to the par-

ticular one we are examining; both must be inmates of this institution at the same time, viz., that of our observation. We infer, then, that a very small number of the sibships of the affected are represented by more than one member in this particular institution. Hence we shall assume that for our purposes each of our affected comes from a distinct family, the error being negligibly small.

That being the case, Column III, besides giving the distribution (proportionately) of the affected in the institution according to size of family to which they belong, also gives the distribution of their families according to size. Let us suppose for a moment that the actual figures are magnified proportionately, and that the figures of Column III actually represent the number of the sibships of various sizes. In that case we should have, then, 46,325 families; hence 46,325 first borns. Again, there being a second born in every family of two or more, we add all the numbers of Column III from the bottom up to the second line and obtain, for the second figure of Column IV, 45,658 as the number of second borns. Similarly, we add all of Column III up to the third line and obtain 44,020 for the third figure of Column IV. In analogous manner we complete Column IV. These figures represent, then (magnified in proportion), the distribution by order of birth of the sibships of the affected. Column VI gives 1000 individuals distributed as are the numbers of Column IV. Now, since all siblings of our community were supposed equally liable to the disease, Column I, besides giving the distribution of our community, also gives the proportionate distribution of those affected. In Column V we have 1,000 individuals distributed as the numbers of Column I. We have, then, in Column V, the per mille distribution of the diseased, as well as that of the community at large, and in Column VI the per mille distribution of the sibships of the diseased.

The discrepancy between the last two columns is striking. Thus, as to first born, the two columns give 165.6 and 124.7 as the respective numbers of affected and their sibships on a per mille basis. A like difference is found for second and third borns. These differences in proportionate distribution were obtained on the assumption that siblings of all orders of

birth were equally liable to disease—that is, that there is no weighting on the early borns. It is not surprising then that Professor Pearson should obtain such differences in his own tabulations, and any conclusions based on such a discrepancy fall to the ground.

We shall further illustrate our point by applying formally the method used in obtaining the above table to the distribution of the 381 patients of a sanatorium used by Pearson in his 1907 paper. We obtain the following table, where Roman numerals denote columns similar to those in Table I:

TABLE II

RECONSTRUCTION OF THE DISTRIBUTION OF THE SIBSHIPS OF 381 TUBERCULOUS INDIVIDUALS IN A SANATORIUM FROM THAT OF THE TUBERCULOUS INDIVIDUALS THEMSELVES, AND A COMPARISON WITH THE SIBSHIP DISTRIBUTION AS ACTUALLY FOUND BY PEARSON

Sibling's Order. / Number in Family.	Distribution of Affected in Sanatorium.	Number of Families of Respective Sizes Represented by I.	Number of Affected Belonging to Families of Various Sizes.	Expected Distribution of the Sibships of the 381 Affected.	381 Distributed as the Sibships of the Affected.	Distribution of the Sibships of the Affected as Actually Found by Pearson.
	I and V	II	III	IV	VI	VII
1 . . .	113	34	34	381	69 69	67 1
2 .	79	38	76	347	63 47	64 4
3 .	41	−11	−33	271	49 57	58 5
4 . . .	52	13	52	304	55 60	50.9
5.	39	21	105	252	46 09	43 5
6.	18	0	0	147	26 89	32 6
7 . . .	18	9	63	147	26 89	23 2
8. . .	9	6	48	84	15 36	16 1
9 .	3	0	0	36	6 58	10 0
10.	[illegible]	0	0	36	6 58	6 2
11. . . .	3	2	22	36	6 58	3.7
12	1	0	0	14	2 56	2 6
13. .	1	0	0	14	2 56	1 6
14. . .	1	1	14	14	2 56	1 1
Total.	381	113	381	2,063	381	381 (a)

(a) This total embraces several siblings of an order of birth beyond 14.

Here Column I or its equivalent, Column V, gives the distribution of the 381 subjects. Column VI gives the distribution of the sibships of these subjects that is to be expected from Column I. Column VII gives the distribution of the sibships of the affected as actually found by Pearson. The distributions of Columns VI and VII are fairly equivalent. But VI was obtained on the assumption that all siblings were equally liable to the disease. Hence the discrepancy that

Pearson found was to be expected on the assumption that there be no weighting according to order of birth. Certainly, then, Professor Pearson cannot use these distributions as a basis for the contention that the early born are especially liable to be diseased.

Again, let us reverse our procedure to see what number of affected may be expected from the actual distribution of the sibships. In Table I we obtained the distribution VI from that of I or V in a very definite way. Given the distribution VI, that of V is then definitely determined. Using Pearson's figures again, we obtain the following table:

TABLE III

RECONSTRUCTION OF THE DISTRIBUTION OF THE AFFECTED IN A SANATORIUM FROM THAT OF THE SIBSHIPS OF THOSE ACTUALLY AFFECTED, AND A COMPARISON WITH THE DISTRIBUTION OF THE ACTUALLY AFFECTED AS FOUND BY PEARSON.

Sibling's Order.	Distribution of the Sibships of the Affected as Found by Pearson.	Distribution of the Affected to be Expected from that of their Sibships.	Distribution of the 381 Affected as Actually Found by Pearson.
	IV and VI.	I and V	VIII
1	381	93.92	113
2	366	78.92	79
3	332	61.92	41
4	289	47.59	52
5	247	37.09	39
6	185	24.69	18
7	126	14.86	18
8	86	9.15	9
9	57	5.52	3
10	35	3.08	3
11	21	1.68	3
12	15	1.13	1
13	9	.63	1
14	6 }	.40	1
15 and over	9 }		
Total	2,164	381	381

Column IV (VI) gives the distribution of the 2,164 sibships of the affected as actually found by Pearson. Column I (V) gives the expected distribution of the affected themselves, and is obtained from VI by reversing the procedure in the other tables. Column VIII gives the actual distribution of Professor Pearson's subjects. Comparing the last two columns, we note that the first, fourth and fifth born predominate. Considered as a whole, however, the variations are too irregular to warrant any definite conclusion. The same chance

variation that made 52 follow 41 in Column VIII may have raised the first figure to 113.

Professor Pearson may point out that, in some instances, he has found variations beyond even what we should anticipate on our assumptions. But we have seen that there are several reasons why we should *a priori* expect a certain predominance of first born among the marked (except, of course, in cases of congenital cataract, albinism, etc., characteristics acquired at birth). Proper allowance must be made for such factors before we can accept any decided difference in our order of birth distributions as really significant.

On reviewing Professor Pearson's data in the light of the foregoing, we find that his hypothesis is anything but substantiated, and that the cry against the pioneer child—at any rate, so far as Professor Pearson's data indicate—has little, if any, justification. It would seem obligatory that the proper method of procedure to be pursued in an investigation such as that which is proposed should be to consider only families of the same size, and that then only families with completed pathologic history should be included. This would eliminate the complication of including a number of early borns of degenerate stocks with low fertility. Again, if any definite results were obtained, we should have some reason to suppose them true for members of the same sibship. Weighting of large families as such (the primary source of the differences in our distributions) would be eliminated. Inadequacies in the records due to omission of the data concerning the ultimate history of young siblings with distinct pathologic diatheses would be accounted for. Any other like pitfalls or sources of inaccuracy must be done away with, or allowed for, before one can feel any assurance that his conclusions, if he then obtain any, include an element of truth.

VITAL STATISTICS WORK IN CALIFORNIA.*

By George D. Leslie, *Statistician, California Board of Health.*

Statistics have been termed the handmaid of prophecy and vital statistics the bookkeeping of humanity. The books kept in California include births, deaths, and marriages, and yield sound predictions on the great events of life—the cradle, the grave, and the wedding altar.

The State Bureau of Vital Statistics was organized in 1905, and California immediately won from the U. S. Bureau of the Census the honor of recognition as a registration state for deaths along with Pennsylvania and three others admitted in 1906. Until the admission of Washington in 1908, California was one of three registration states west of the Mississippi River and the only such state beyond the Rocky Mountains. Moreover, there is a sharp contrast between mortality statistics for the two registration states on the Pacific coast. The death rate for Washington has ranged widely between merely 7.9 and 10.0 per 1,000 population, while the rate for California has varied slightly at higher levels only from 13.4 to 14.6. The California death rate was below that for the whole registration area in 1906 to 1911, though somewhat above it in 1912 and 1913.

Birth registration, deficient at first, has improved year after year in California, the total more than doubling between 1906 and 1914 in the steady rise from 20,974 to 46,012 and the rate advancing from 10.3 to 16.7. In the race between the Stork and the Scythe, births first surpassed deaths somewhat in 1911 but by 1914 the excess of births over deaths rose to over one fifth (22.6 per cent.). The California death toll was 29,303, or 14.4 per 1,000 population in 1906, against 37,537, or only 13.4 per 1,000 in 1914, increases appearing annually except for a small decline between 1908 and 1909 and a sharp drop between 1913 and 1914, when the death total decreased by 1,062, or 2.8 per cent. Marriages numbered 21,317, or

* Paper presented at the meeting of the American Statistical Association at Stanford University, Palo Alto, California, August 13, 1915.

10.5 per 1,000 inhabitants in 1906, against 31,902, or 11.5 per 1,000 in 1914, a decrease of 1,266, or 5.5 per cent., appearing between 1907 and 1908, while all other years showed successive gains but with increases very small and rates actually declining in both 1913 and 1914.

The registration system established in 1905 has been modified by a new statute in effect August 8, 1915, that follows even more closely the Model Law on this subject and which, though altering standard blanks and local districts somewhat, will make no particular change in statistical tabulations. However, descriptions here given of blank forms and registration districts relate to conditions under the law of 1915.

The California birth and death certificates are based upon forms recommended by the Bureau of the Census and the marriage certificates follow similar lines. Each blank contains identifying particulars such as names of persons and parents as well as the place and date of the event, in addition to statistical data proper. The birth certificate includes the following statistical items: sex of child; whether twin or other plural birth; for each parent the race, age, birthplace, and occupation (by both particular kind of work and general nature of industry); number of children born to the mother as well as number still living; and also inquiries on the use of a prophylactic for ophthalmia neonatorum. The death certificate contains for each decedent the sex, race, marital condition, age, occupation (by both particular kind of work and general nature of industry), birthplace, parental birthplaces, cause of death, and length of residence (in the registration district and in California), together with special information for hospitals on source of infection. The marriage certificate likewise includes the following items for both groom and bride: race; age; former marital condition with number of present marriage; occupation; birthplace; and parental birthplaces.

The local registrars forwarding to the central bureau each month original certificates for births and deaths in their respective districts are the health officers of the 34 cities having freeholders' charters, the clerks of the remaining 205 cities and incorporated towns, and the county recorders for the outside or unincorporated portions of the several counties. Orig-

inal certificates for all marriages are likewise sent each month to the State Registrar, but only by the recorders of the 58 counties in California. The duty of filing a certificate with the local registrar is fixed by law upon the physician or midwife attending a birth within 36 hours thereafter, upon the undertaker, in case of a death, within 72 hours or before any disposition is made of the body, and upon the minister or justice performing a marriage ceremony within three days of the event.

Some idea of the extent of tabulations in the State Bureau of Vital Statistics is given by a general summary of the facts for California in 1914, to appear in the next Biennial Report. Similar figures are shown regularly in these reports for three main divisions—Northern, Central, and Southern—and eight minor geographic divisions of the state, and are generally available likewise from data published for individual counties as well as for leading cities.

Males preponderate greatly among the inhabitants of Western States, the proportion of males to 100 females having been 125.5 for California in 1910 against merely 106.0 for the United States. Consequently, among decedents here the proportion of males is over 60.0 per cent. (61.4) as compared with only about 55.0 for the whole registration area. For California births, however, the percentage of males is only 51.7, being 51.5 among white babies against 53.6 among non-Caucasians, mainly Japanese. The percentage of male births is 51.2 for California mothers, 51.1 for other Americans, and 52.4 for foreign born white mothers.

With reference to race, the percentage of non-Caucasians is 8.1 for babies born, 5.4 for persons dying, and 4.6 for those marrying. The Japanese birth total, though only 719 in 1910, has risen rapidly to 2,874 for 1914. While births and deaths of Japanese occur at various places throughout California, the Japanese weddings take place to the extent of nineteen twentieths of all at San Francisco. Picture brides from Japan find expectant grooms assembled at this port, the marriage certificates being filed in dozens after the arrival of trans-Pacific steamships.

For the white elements of the population, the nativity is as follows in per cents.:

	California.	Other States.	Foreign Born.
Births (Mothers).......	31.0	39.3	29.7
Deaths (Decedents).....	26.5	42.0	31.5
Marriages (Brides)	36.4	43.3	20.6

Comparison of percentages by nativity for white mothers and brides indicates that native Californians and other Americans show less strongly among women bearing children than among those marrying, while, conversely, foreign born women contribute relatively more to birth rates than to marriage totals. The same contrasts appear when widowed and divorced brides are omitted and the comparison is made between all mothers and only first marriage brides. It seems, therefore, that in this state as elsewhere the fecundity of foreign born women surpasses that of the natives.

In regard to age, tabulated only for deaths, it appears that people live longer or die older in California than in the United States generally, the median age for decedents in this state being 49.6 years against the last published figure of 42.7 years for the whole registration area. In 1911 to 1914 the median age for California decedents was successively 48.8, 49.2, 49.4, and 49.6, indicating an upward movement even though slight. While the median age is somewhat less for males than for females in the entire registration area, 42.2 years against 43.4, it is considerably higher for men than for women in California, 50.1 years against 47.3.

For decedents of 15 years and over the per cent. distribution by marital condition is as follows for each sex:

	Single.	Married.	Widowed.	Divorced.	Unknown.
Males.........	31.5	45.3	14.5	1.8	6.9
Females.......	11.9	48.7	36.9	1.3	1.2

In further reference to marital condition, the status of grooms and brides may be noted in the following per cents.:

	Single.	Widowed.	Divorced.
Grooms...............	83.1	8.5	8.4
Brides	79.2	10.0	10.8

The per cent. of divorced brides, 10.8, marks a steady annual rise from only 7.4 in 1907. Divorced women outnumber divorced men even more than widows exceed widowers. Although widows outnumbered divorced women remarrying in the period 1906 to 1911, yet for the years 1912 to 1914 the divorcees have surpassed widows in increasing degree. However, the per cent. divorced is higher for brides born in other states than for native Californians, though lowest of all among foreign born brides.

Classification of marriages by number in order shows that there are many more weddings between bachelors and widows or divorcees than between single women and widowed or divorced men. Moreover, bachelors unite with divorcees much more than with widows, although spinsters marry widowers about as much as they wed divorced men. Yet where persons previously married wed again with others of prior matrimonial experience the mate for either sex is somewhat more often one who was widowed rather than divorced.

Analysis of mortality statistics by occupations for California cannot be presented satisfactorily here, the tabulations for this state being made for 90 specific occupations and for 12 groups of diseases. Discussion of causes of death is also necessarily omitted at this time. The annual tabulations published for the state cover each of the 189 titles of the International Classification by sex, race, nativity, and age periods, while figures are also given for geographic divisions as well as for individual counties and chartered cities on total deaths classified by 28 principal causes.

Reference must be made, however, to valuable data compiled for California on the length of residence of decedents, this information being particularly important in connection with the heavy mortality from tuberculosis in this state. The "Great White Plague" causes about 14 per cent. of all deaths in the whole state and about 17 per cent. of the deaths in Southern California. Yet over half the tuberculosis victims in Southern California had lived in the state less than ten years. In fact, the length of residence was under one year for 13.4 per cent. of these decedents and less than six months for 8.7 per cent. of them in 1914, the per cents. for 1914 being much

lower than averages for preceding years on account, perhaps, of decreased migration of tuberculosis sufferers in a year of financial stringency.

Furthermore, nearly one fourth (23.4 per cent.) of all California decedents with a residence of under one year were persons who finally succumbed here to tuberculosis contracted undoubtedly elsewhere. Hence, the very healthfulness of the California climate is a factor in swelling the general death rate or apparent mortality. People come here to save or lengthen lives surely doomed elsewhere.

THEORY OF STATISTICAL TABULATION.

By G. P. Watkins.

This brief paper deals with statistical tables in their most general aspects and is therefore labelled the "theory of tabulation." But it is a product of experience and indeed was conceived and in part written as a general introduction to directions and rules of tabulation for use in a statistical office. Hence in form it consists largely of statements of how things should be done. But the purpose and function of statistical tables are the fundamental thoughts throughout.

Nature of Tabulation. The general meaning of the word "table" appears to be an even flat surface with breadth not disproportionately small in comparison with length or, concretely, an object characterized by the possession of such a surface. The arrangement of ordinary reading matter is in a line or lines, while a statistical table presents itself as a surface.

The table thus differs from the ordinary page of letter type not merely in being composed mainly of figures, but also in being readable in two dimensions, that is, at least vertically as well as horizontally. "Reading matter" may also be a list of numbers. But the arrangement of the line (or "lines") of ordinary reading matter running back and forth on the page is not on a surface plan. A line of running print can be followed but one way. Such a line is like a string of beads, but with the type (as the beads) interrupted on the parts of the string extending from right to left and in position on the string as the line passes from left to right. The reader's eye must follow the string. A statistical table, on the other hand, can be read either down or across. It utilizes the dimensions of a surface. According to this conception, a list is not a table and a single column does not constitute a table.

A table may also sometimes be read diagonally, especially one of content and form such as to show correlation. The ages of men and of their wives, the age and the grade of school children, etc., may conveniently be compared with reference to the most frequent combinations in this way.

Matter not of a statistical character may also be put into a table when there is some advantage in reading it more than one way. Numerical data, whether statistical in character or not, are frequently best so arranged. The tabular form is used to furnish data for, and facilitate the processes of, computation, as in the familiar tables of logarithms, trigonometric functions, roots and powers, etc., and in interest tables. Here compactness of form and ease of reference are the important considerations, but these are also the reasons for being of the statistical table.

The implied division of numerical tables into two species, mathematical and statistical, suggests a question as to what is the difference between the two. The answer is that the first species contains abstract numbers, and the second, numbers that are at least relatively concrete. Statistical tables consist of numbers representing quantities or degrees of *concrete* things, qualities, or events. Hence the importance of statistical units and of their definite and constant significance. Indeed, the writer would describe statistics in general as concerned with concrete numbers and quantities and their relations. It constitutes a characteristic method or methods of dealing with such numbers, and also consists of the material appropriately so dealt with. These two aspects of the subject tend to be recognized in ordinary speech by the use of a singular verb with "statistics" in the first sense, while in the second sense the word is treated as plural. For statistics, in either sense of the word, the importance of the table is evident. This conception of statistics, it may be added, has important general bearings not involved with its incidental use in the present connection.

Tabular presentation has conspicuous advantages as regards economy of space and of time: of space, wherever the same class designation or name is to be applied to a large number of items brought together in the table in a single line or a single column; of time, on the part of those seeking information on a specific point, in that, by using line and column as guides, the specific fact sought can be found directly. These uses of the tabular form are not peculiar to numerical tables.

Tabulation, like speech, is a device for expressing ideas, and in particular for expressing them compactly and in a way to facilitate comparison and show relations. Ordinary linguistic symbols, arabic and other numerical notation (including the symbolic use of position), rulings and spacial relations, and sometimes forms special to tabular notation, are all employed for this purpose. As with language generally, the tabular presentation of facts should say as much as possible with a meaning as unmistakable as possible in as small a compass as possible. There should be no ambiguity, hence, for example, blanks should mean but one thing. Expression should be as direct as possible, hence, for example, information essential to a prompt grasping of the meaning of the table should not be put in footnotes if avoidable. Reasonable conventions regarding the use of symbols should be observed.

The table is the fundamental means of presenting statistical material and is so characteristic of the method that it may be considered the matrix of statistics. Those who first gave to "statistics" its present meaning, as distinguished from its older sense of "political" science, were opprobriously called "*Tabellenknechte.*" As early as the '40's of the nineteenth century, New York State provided for the publication of railroad reports *in tabular form.** Statistical competence may well be described as knowledge and skill in making and interpreting tables of concrete numerical data.

Uses of a Statistical Table. The stub of a statistical table is most commonly a geographical classification. For groups of such classes there will usually be sub-totals which condense the more detailed classification. But the stub may consist of the names of reporting entities, as in the case of many primary tables of corporation and financial statistics. The most important statistical data for public-service corporations are usually printed in such form by the various supervising commissions, including the Interstate Commerce Commission. But for much such data, especially for the distinctively statistical as opposed to the financial part, the company unit has little significance and compilations are made by geographical or other groups of companies. Where the facts are presented

*1907 Annual Report of the N. Y. Public Service Commission for the First District, Vol. 1, p. 452.

by reporting entities, the tabular form may serve the purpose merely of saving space, but the totals, which are of more statistical interest, are best obtained, and their composition best shown, by way of a table. If it were possible to provide the necessary space, it would of course be best always to tabulate by such return or report units, so that the person who used the primary data could make his own groupings and combinations. However, especially where the enumeration or report unit is the individual or the private family, aggregate presentation is unavoidable. Hence the stub-items of a table represent classes, rarely also composite individuals. In publishing statistics of manufacturers and other private business enterprises, the presentation of the facts for one or few companies by themselves is expressly avoided as tending to reveal the operations of individual establishments to competitors. Such procedure on the part of the U. S. Census Bureau and the various bureaus of labor statistics is undoubtedly wise administratively, though the fact that a large business corporation with stock broadly owned cannot properly withhold from the public any sort of statistical or financial data that is of general interest should be recognized and doubtless will in time be accepted in practice. But at present only quasi-public corporations appear to be dealt with statistically according to this principle.

The statistical interest of a geographical stub is, of course, not of the highest rank. The consideration determining its use is the fact that a general or primary table is in the first instance a record and repository of data. Only to a very subordinate extent is it wise to attempt to exhibit relations and significance in such a table. In a derivative (analytical or text) table the interest is of course different. But the arrangement of the items even of a geographical stub may be made to serve the purpose of explanation where, for example, the order of magnitude or of density is followed. In the New York First District Public Service Commission reports, the arrangement of lighting companies within groups determined by intercorporate relations in the order of size (amount of revenues) somewhat increases the statistical interest of the stub, since it is a step towards making the table show correlation.

It also puts first the companies in which a reader is likely to be chiefly interested, thus facilitating reference—which fact is doubtless of more practical importance than the slight aid afforded to interpretation. The order of the street-railway groups of companies in the same series of reports is in a general way that of expensiveness of line construction. These touches of correlational arrangement are suggestive of a use of tabulation which seldom affects primary tables. The correlational use, however, supposes the captions as well as the stub-items arranged according to the degree of some quality, and thus it involves cross-classification. Primary tables ought to be planned with reference to such possible use. Perhaps the presentation of such cross-classifications might well take the place of some geographical detail.

A statistical table is often merely, and always incidentally, a presentation of items going to make up a total or series of totals. The separate columns may accordingly contain things having little or no relation to each other and they may be given together merely to save space by making unnecessary the repetition of the stub. The unity of a table, however, will usually mean more than this. But it is doubtless the first or simplest purpose of a table to show this or that aggregate and how it is made up. The stub-items constitute the individual or class names for the things of which the numbers are the entries. The entries are themselves usually aggregates. But it is possible to use the tabular form for a mere tally sheet, in which case the entries represent the individual things.

In general the stub-item of a statistical table stands for a group or class of things, and the stub contains the terms of a classification. Classifications in statistics, it should be noted, must be comprehensive, hence there is usually need of an "other" or "miscellaneous" class, and commonly also of an "unknown" or "not specified" class. For the rest, all the principles conducive to right classification apply to stub and caption classifications.

It is above implied that the captions, also, as well as the stub-items, will usually constitute a classification, or perhaps more than one classification. The fact that columns commonly

add across to a total column supposes this situation. The statistical table thus becomes a mode of cross-classification.

In this more highly evolved use of the tabular form, a statistical table is essentially an arrangement of numerical data by which the data are cross-classified according to two sets of terms, those of the stub and those of the captions. The device of sub-classification is also frequently introduced in the captions and stub by way of compound captions, sub-division of stub-items, and sub-totals. The more complicated classifications usually require additional tables in series.

Instead of the terms of a classification, a time series, especially a succession of years, may be used in the stub and have much the same relation to the entries, except that column totals are then not always significant. But such a table is usually derivative.

Limitations upon Tabular Presentation. Cross-classification corresponds to what is known in algebra as combination and is covered under the topic, "Permutations and Combinations." The mathematical principle is that the number of possible different combinations of one set of things or classes of things (enumerated in the stub-items, let us say) with another set (enumerated and described in the captions) is equal to the product of the number of items in each set. This gives the number of cross-classes or entry-places in the table. There should be occasion to use most of these, or else the form of the table needs revision, or at least condensation.

The fact that cross-classification is a process of combination serves to bring out an important limitation upon the possibilities of tabular presentation. It is often desirable to show the associations or combinations of the units under three classifications or sets of cases. If the third of these classifications is merely twofold, the space required is merely double what it was before. If there are 12 rubrics under the third classification, the normal requirement is for 12 times as much space, or probably 13 times as much, since a total of the 12 classes will be desirable. If the original stub provides for 30 items and there are 10 columns, a presentation of all the possible combinations with a further series of 12 classes will require 30 x 10 x 12, or 3,600 cross-classes or entry-places.

If it is desired to show completely by tabulation the relations between nativity in 12 classes, age in 10 classes, sex in 2 classes, residence in 50 classes, and occupation in 100 classes, supposing every possible combination will require an entry-place, the number of cross-classes will be 12 x 10 x 2 x 50 x 100, or 1,200,000. If the 50 residence rubrics are made the items of the stub and 10 columns may be put on a page, that would mean 500 entry places to a page. The presentation of the facts would, therefore, require 2,400 pages. But the number of rubrics under each classification is fewer than it might be desirable to use. The above computation, moreover, does not provide for totals. Of course, much space could in practice be saved by reason of the omission of provision for impossible or infrequent combinations. Young children, for example, will not be found in occupations. However, the limitations upon what we may call *complete tabulation* are evident. The size of census volumes, even with their limitations, is thus explained.

The difficulty in question is avoided by seldom attempting complete tabulation. Some of the combinations are not important or not of special interest. The classification of those in a specific occupation by nativity, for example, is of interest for comparatively few occupations and comparatively few localities. It may often be assumed that the variation within one kind of classification in terms of another classification will be so small that a presentation of the facts for all of the first class combined will sufficiently meet ordinary statistical requirements. Detailed compilations also may often be made to serve for a number of years, provided the proportions found are representative and quite constant. The frequent necessity of resorting to such methods—the necessity in particular of using alternative classification instead of cross-classification—explains why a given statistical compilation will seldom enable one to answer all the questions for which a solution is sought. The facts are contained in the returns but they cannot all be presented.*

*Table XI of the 1911 street-railway report (in the volume on transportation statistics, Volume II of the 1911 Report of the New York Public Service Commission for the First District), dealing with Accidents, shows in Division C a classification of injuries by occasion and a separate classification by degree of seriousness, but the relations between the two classifications are not shown, that is, the classifications are

A report schedule from which tabulations are made is commonly itself in tabular form and may contain a cross-classification. Only one who has had practical experience with the problem of devising a general table or tables to contain what is most important in such returns can appreciate the difficulty of obtaining satisfactory results in a limited space. But the reader is prepared for an application of the theory of mathematical combinations to such a case. If only 50 such report schedules are to be tabulated in a way to show the individual returns and supposing the schedule has 10 stub-items and 20 captions, then in order to present *all* the facts it would be necessary to provide at least 200 columns of 50-line tabular matter. Alternative tabulation, on the other hand, which would utilize only the cross and down totals of the schedule, would require 30 columns. It is assumed, of course, that the data of each schedule are themselves aggregates and that each such aggregation has interest of its own. If only the totals for the 50 returns taken together are wanted, only as many entry-places are required as are contained on one of the schedules, that is, $20 \times 10 + 31$ (for totals), or 231 in all—which is a table of modest dimensions. Enumeration schedules, it should be noted, are not often of a character to raise this question in just this form.

Detailed classification according to geography or locality is, as has been stated, not of statistical interest in proportion to the amount of space it takes in primary statistical publications. Every locality, however, has a neighborhood interest

alternative and do not make a cross-classification. Disregarding the difference between "accidents," "killed," and "injured," under occasions—which in fact presents in part the facts regarding the seriousness of the result—there are 5 occasion rubrics (as condensed from 22 in the annual report form) and 6 seriousness rubrics. To present all the possible combinations of these would require 30 columns instead of the 11 at present required. The same facts, with a somewhat more detailed classification by occasion of injury (disregarding, however, the number of accidents) are sub-divided between passengers, employees, and others in the three parts of Division D. If, instead of the mere distinction between killed and injured in Division A of this table, the subdivision provided for all classes of injuries and a total, 4 x 11, or 44 columns, would have to be added. Six columns might be dispensed with, but should be kept as totals.

A reduction of what would otherwise be the undue length of Tables XXXIII and XXXIV in the employees and wages statistics of the 1911 report for lighting companies (Volume III of the 1911 Report of the New York Public Service Commission for the First District) is effected by using a condensed stub in which systems or groups take the place usually occupied by individual companies. This requires the preliminary tabulation of company returns to get the totals thus printed. The use of the full company stub would increase the length of Table XXXIII in the ratio of approximately 8 to 36. Instead of occupying 19 pages, it would take 86.

in facts about itself, which the Census Bureau and other statistical officers feel called upon to cater to. Statisticians, also, often appear to want a great amount of local sub-division of the primary data.* This demand is largely the result of attempting to show the degree of connection between various sorts of social conditions by way of comparative cartograms or of corresponding numerical analysis, a method which is in effect crudely correlational. This purpose could be better served by re-counts of the punched cards pertaining (say) to a given city, with reference not merely to showing the relation between certain conditions and certain localities, but to tracing actual connections (the individual or family being the unit) so far as the data compared came from the same schedules. But for comparison with data from diverse sources the cruder cartogramatic method might be necessary, which, however, would be aided by an adaptable locality classification. For such purposes the re-counting of census cards by responsible private agencies, as well as by the Census Bureau itself after the decennial rush is over, ought to be facilitated and encouraged wherever it would serve a public object. Something of this sort, rather than further local detail, is the true statistical desideratum.

One way in which the Thirteenth Census meets the problem of voluminousness resulting from geographical details is interesting in this connection. Instead of such details being furnished for all the states together, the Abstract has a supplement for each state giving the geographical detail for it alone. Thus such local details are furnished only so far as they are interesting and useful to each class of readers.

With our present-day mechanical facilities for "tabulation," the process of sub-division and cross-classification of aggregates is limited rather by the degree of significance of the results, and by the cost and awkwardness of voluminous reports, than by the time required to make the necessary sortings and counts of cards already punched. While the mathematical theory of combination is a good point of departure in planning

* Cf. Robert A. Woods, Unit Accounting in Social Work, QUARTERLY PUBLICATIONS OF THE AMERICAN STATISTICAL ASSOCIATION, March, 1913, Vol. XIII, p. 361. This paper was read at the 1912 annual meeting. Unfortunately, the discussion that followed is not printed.

tables, most combinations of the terms of diverse classifications, even if they occur, have no concrete significance.

Comprehensiveness, Comparability, and Compactness as Essentials of Good Statistical Tables. The significance of a statistical table, as of statistics generally, depends very largely upon its being comprehensive for the field it covers. Truth in its statistical aspect is representativeness. The only absolute guaranty of the representative quality of an aggregate is that it reflects all the units within its scope. According to the mathematical theory of probabilities, much less is necessary, but this theory does not take account of the selective tendency of events and of observation, for which the statistician must be continually on his guard. The point is illustrated by the well-known difference in quality between results obtained by complete enumeration and those obtained from a circular letter or questionnaire.

A table should not be composed of mere samples. It is better to make it of narrow scope but comprehensive as far as it goes, *i. e.*, within its territorial or other limits. A table, furthermore, is likely to be one of a series, which should all be on the same basis or, at least, conform sufficiently to the basis of the series so that its representative quality and the comparability of its totals are not appreciably impaired. The most surely understood uniform basis, meeting all the requirements of comparability, is the comprehensive basis. When a table falls short of the basis of its fellows, but in a way not such as to compel its omission altogether, the appropriate place to indicate what is lacking is a general note. Sometimes it may be well to have two sets of totals to a table, one on the most comprehensive basis, and one less comprehensive, but such as to supply aggregates for data that, though falling short of perfect comprehensiveness, may be of qualified value in other ways, as for example, in the computing of ratios. On the other hand, if it is desirable to present information in connection with only one of a series of tables, it is well, in order to avoid impairing the comparability of one table with the others of the series, to put the data that exceed the standard scope in brackets and not take them into the totals, thus letting them be *in* the table for purposes of

reference, but not strictly *of* it. Uniform comprehensiveness upon some definable basis is the ideal standard. Even a small per cent. impairment of comprehensiveness may mean a large decrease in tabular efficiency.

The same principle applies with reference to corresponding tables for a series of years. While it is desirable that new data be made use of, full notice of a change of basis should be given and it is often well to give figures and make comparisons on both the old and the new basis for the first year of the change. Especially in derivative tables attention to comparability is imperative, without regard to cost in the way of added complexity, etc. Ratios, for example, should usually be given on both bases where there is a change. This again is a question of representativeness, though here differences between aggregates, rather than the aggregates themselves, are under consideration. How important this question is in another of its phases is illustrated by the place commonly given to averages, *i. e.*, representative numbers, as the gist, if not the substance, of statistics.

The complement of the requirement of comprehensiveness is that of compactness. It is of the essence of a table to convey a large amount of information in a small space. Hence sparcely tenanted columns are an eyesore, and blank columns, even where the original classification may have reasonably planned to use them, should not be tolerated. Blank lines are hardly less justifiable. Classifications should be revised when the data as spread out show such waste of space. Unrepresented classes may be disposed of in the notes. Sparsely tenanted columns should be consolidated, subdivisions of entries being indicated by footnotes if desirable. A "miscellaneous" column may often be employed with reference to such residual classes. It should never include more than a small per cent. of the material of the table. But sometimes the desirability of keeping up tables on a uniform plan, *e. g.*, through a series of years, may justify continuing sparse columns till a comprehensive overhauling of the form of tables is undertaken.

The table must ordinarily be planned with reference to fitting the printed page, as single-page lengthwise, single-

page upright, twin upright, or as a series of such. Hence dimensions in terms of columns and lines must often be carefully studied before being finally fixed. The large page and the resulting unwieldy size of most statistical volumes are due to the need of space for manoeuvering the tabular matter. Often the presentation in sections of what is functionally one table becomes necessary.

General Tables and Derivatives Tables Distinguished. A table serving primarily the purpose of a repository of comprehensive statistical data is distinguished as a general table, also, with reference to its being closest to the original data, as a primary table.

Derivative tables are summaries and auxiliary ratio tables. They may usually be distinguished as text or analysis tables. But some ratio tables, or at least some ratios, are often included among general tables. Derivative tables are based upon general tables and contain matter suitable for incorporation in analysis. They may vary in form from year to year according to the exigencies of the situation and according to the points emphasized in the text. Unlike the general tables they will usually contain data and comparisons, including absolute and per cent. increases, for several years. Just as general tables serve to show in terms of absolute numbers the composition of aggregates, a derivative table frequently serves the purposes of explanation correspondingly by means of per cent. distribution. If text tables contain data taken direct from returns, these are so treated because of lack of comprehensiveness in the data, or of perennial interest in that kind of data. Explanatory and qualifying statements contained in general-table footnotes should, unless unimportant, be either repeated or referred to in footnotes, or in text immediately adjacent to the text tables.

It is the common practice of statistical bureaus to number tables serially for each report. If Roman numerals are used for the general tables, arabic numerals are used for derivative tables, or *vice versa*. The United States Census has in general employed arabic numerals for the serial numbers of general tables and roman numerals for text tables, but in the Thir-

teenth Census volumes the text-table numbers are arabic and roman numerals seem to be reserved for general tables.

No strict line can be, or need be, drawn between what should go into general and what into text tables, though the fact that ratios are logically a part of the analysis gives the analytical text, if there is any such, a strong claim upon them. Grand totals certainly go with the general tables not only as closing them up but also because of their importance as a proof check. But divisional totals serving the purpose of a summary may go in either place. Ratios, too, may come to have so thoroughly well-established a place as to be in effect a part of the data that the public will expect to find in connection with the general tables. A derivative table in a report containing the corresponding primary tables is seldom to be considered a thing by itself to the extent of requiring no reference to its sources on the part of a reader who uses it carefully.

Comparisons with previous years—or with corresponding months (or other portions) of previous years—are also strictly a part of analysis, but their significance is so direct and their meaning in general so unmistakable that some of them may well be looked for in the general tables. They are made much of especially in commercial and financial statistics. The United States Census is liberal in presenting comparisons for previous decennial years in its general tables.

General or primary tables rightly occupy the largest place in most government statistical publications. Indeed, some official statisticians feel that the preparation and presentation of the primary tables is their whole duty. But some working-over of the raw material by those directly concerned with its compilation is desirable, if for no other reason than the beneficial reaction on the original data and tables consequent upon analyzing and applying them to the solution of scientific and practical problems. Proper emphasis upon the function of such statistical publications as sources does not preclude brief suggestive analysis, in addition to the necessary descriptive and cautionary remarks.

The Rounding and Abbreviation of Numbers. The use of rounded or cut-off numbers should seldom be adopted in general or primary tables, though doubtless desirable in

derivative or interpretative tables. The practice is often recommended without reference to, or due emphasis upon, this very necessary qualification.

Even in derivative tables, the giving of a large number, for example, millions of inhabitants, to the last digit would mislead by its supposed suggestion of "spurious accuracy" only in the case of a reader who would have at least equal difficulty in understanding what the rounding of the figures meant. The notion that we should print numbers showing the digits only in so far as they are known to be accurate, or on the basis of the theory of probabilities considered to be so, is impractical to the height of absurdity. The truth of the stated population of New York City—4,766,883 in 1910—is not of a nature to imply that the figure 3 in the units place has statistical significance. The statistician knows that the last four digits are neither more nor less accurate or truthful if made to read 7,000 instead of 6,883. He does not need to be reminded that the 117 has no objective or exact meaning in such an aggregate. It is seldom necessary to indicate that large numerical aggregates are approximate as to the right-hand figures.

But there is also a positive objection to the rounding of such numbers. From the point of view of statistical administration it is important that, for example, the population of a large area be the total for all its parts down to the smallest district for which separate figures are given, some of which in the instance referred to actually have less than 117 inhabitants. Rounding an absolute number is never obligatory and should never be done in a way to deprive anyone of the possibility of completely checking the number and of using for this purpose, if for no other, the unmodified original aggregate. Primary numerical data should not be rounded.

As regards ratios, too, their mechanical computation with equal ease to a larger as to a smaller number of places makes the decision of how far they should be carried a question of conventional expectations and of economy of attention rather than anything more fundamental. This statement does not refer to (and does not apply for) slide-rule computations. The carrying out of ratios to two decimal places (or for per cent. to hundredths of one per cent.) seems to be the most

satisfactory practice for most cases, so far as fractions are desirable, though only the first place will usually be itself significant, the second serving rather to qualify the first. Where three decimal places are used, the printer, and sometimes the reader, will easily mistake the point for a comma.

But much depends on how far it is the statistician's aim to make his material popular—an end that is, of course, entirely worthy in itself. The desirability of rounded and abbreviated numbers, also of the use of few numbers, in statistical exposition is chiefly of the same nature as are the claims of stylistic elegance or of force (as a writer may prefer or the conditions require) in the use of the English language. The first duty of one presenting statistical results is to be adequate and accurate; if possible it is well for him to be also elegant, or forcible, or whatever else may be desirable, in his choice of words and of numerical expressions.

The process of rounding or cutting-off numbers is by no means simple or a matter of course. On the contrary, it requires considerable statistical technique—else totals will be found not to check with items and ratios not with the data from which they are derived. It may be noted incidentally that where it may seem desirable, as frequently in the case of estimates, to round or abbreviate both a relative number and the corresponding absolute number, one cannot do both and at the same time preserve the requisite verifiable relation between the two. This fact counts against the rounding even of estimates, though some sign of approximation is in such cases especially desirable.

Tabular Notation. The rounding and abbreviation of numbers is strictly a part of the subject of tabular notation, but so fundamental as to affect the character of the statistical table as such. The word "notation" properly refers to the relation between the signs and symbols used to convey the meaning of any part of the table and the significance arbitrarily or conventionally attaching to them. To illustrate, it would seem that the last two digits, 83, of the figure for the population of New York City in 1910, preceded as they are by five other digits having the significance of position proper to them according to the arabic numerical notation, ought, without

difficulty, to be interpreted as having a different statistical significance from the figure 83 as arrived at, for example, by a careful housewife on inventorying her pieces of silverware preparatory to putting them into safe deposit, or by a dairyman counting his stock.

The signs used in tabulation are chiefly arabic numerals and the letters of the alphabet in their various appropriate combinations. The position of such a sign may be a part of the notation. The notation of a table is the language in which its import is expressed; and that language should be as direct, concise, and unambiguous as it is possible to make it.

The technique of statistical notation has not reached a high stage of development. The writer, at any rate, feels that the tendency among statisticians to treat a table as a mere repository of numbers and to indicate in footnotes any state of facts not so represented is objectionable. The absence of a report, the failure to segregate returns, the character of an entry as estimated or as incomplete—all these are matters that can be shown by appropriate signs on the face of the table. The best policy would seem to be to make the tabular entries self-explanatory to as high a degree as possible, for the purposes of the particular tabulation, by the use of word or other non-numerical sign entries where feasible. Footnotes are thus reserved to supplement or qualify both numerical and sign entries and especially are not intended to take the place of lacking numbers. But the technique of tabular notation lies outside the scope of a discussion of the general aspects of statistical tabulation.

VITAL AND MONETARY LOSSES IN THE UNITED STATES DUE TO PREVENTABLE DEATHS.

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The purpose of this paper is to set forth the results of a statistical investigation of the vital and monetary losses in this country due to the occurrence of preventable deaths; to show (a) to what extent the average length of human life is affected by the occurrence of such deaths; (b) the effect on the expectation of life, or average future life time, at any age; (c) the effect on the death rate, at any age; (d) how great a monetary loss is sustained through such a death, assuming that the life of every person has a value, or that during the most productive period of his life—say from the age of twenty to seventy years—every person contributes something annually to the wealth of the community in which he lives; and (e) the total value of these losses, estimated for each age for both males and females, for the whole country.

We have obtained the results set forth in this paper through the comparison of mortality tables which we have constructed and which are based upon the different sets of conditions and hypotheses that are to be introduced and discussed; and a familiarity with what is involved in a mortality table and the expectation of life is so essential to the complete understanding of what follows that we shall now explain briefly what these terms imply.

A mortality table is first of all a table of death rates computed for the different ages of human life. In addition it also exhibits the effects of these death rates upon an arbitrarily chosen community in the following manner. First, a large number of persons is assumed to be living at exactly the same age, usually at the age of birth; then the number of deaths for this age is ascertained by multiplying the number living at the age by the corresponding death rate; and, finally, the difference between the number living, or population, and the number of deaths gives the population at the next higher age. The populations at all the other and higher ages are

found successively in the same way. If we let l_x represent the population or the number of persons living at age x, d_x the number of deaths and q_x the death rate, the mortality table would appear as follows:

Age.	Population.	Deaths.	Death Rate.
0	l_0	d_0	q_0
1	l_1	d_1	q_1
2	l_2	d_2	q_2
x	l_x	d_x	q_x
x+1	l_{x+1}	d_{x+1}	q_{x+1}

where, as explained above, $l_{x+1}=l_x-d_x$

Such a table not only shows at what age the last survivor dies but also provides a means of computing the average future life time or expectation of life. Thus a mortality table based upon the death rates known to exist in a given community sets forth concisely and clearly the mortality conditions of that community, and the mortality conditions of any number of communities are very easily and readily compared by means of such tables.

Obviously, all those that survive from any year of age to the next have each lived one year; hence, if we add together the survivors of all ages beyond any particular age we shall obtain the total number of years lived by those at that age; and, finally, if we divide this total number of years by the population at the age considered we shall obtain the average future life time or expectation of life of persons at that age.

Since a death is just as apt to occur at one time in the year of death as another it is usually assumed that a person will, in the long run, live a half year in the year of death, and this one half of a year is added to the average future life time explained above to obtain what is called the complete expectation of life. Expressed symbolically, the complete expectation of life at age x, or

$$\mathring{e}_x = \tfrac{1}{2} + \frac{l_{x+1} + l_{x+2} + l_{x+3} \div - -}{l_x}$$

Some of the general though important aspects of the subject under discussion have been investigated by means of short-cut methods. The use of mortality tables, however, has two decided advantages over the short-cut methods; its accuracy insures greater confidence in the results; and the results are given for each age, whereas those of the short-cut methods are given only for the age of birth.

In preparing this paper we constructed a mortality table (Table I) based upon the actual death rates found to exist at the present time in those sections of the United States where reasonably accurate mortality statistics are available. We then constructed another mortality table (Table II) based upon mortality conditions that would exist if preventable deaths were actually prevented. A comparison of these mortality tables forms the basis of our discussion of the vital and monetary losses due to preventable deaths.

It is practically impossible to give a rigid definition of a preventable death. Even if it were possible to know all about the various causes of death, different viewpoints would lead to different decisions as to the preventability of most deaths. Instead of trying to define a preventable death in such a way, we have made use of a set of ratios or percentages collected and arranged by Professor Irving Fisher of Yale University, who sent a list of ninety diseases to each of a group of the most prominent medical authorities in this country and asked them to designate what per cent. of the deaths due to each disease they considered preventable.

To quote from Professor Fisher:* "Since the word 'preventable' implies the hypothesis of different conditions from those which actually exist it is necessary to specify what hypothetical conditions shall be implied in the term. Doubtless tuberculosis would be over 99 per cent. preventable if we should conceive as our hypothetical conditions that every individual could live on the prairies of the west, out of doors, be provided with the best of food, most congenial of tasks, and free from overwork and worry. Needless to say, the figures in the table do not imply such Utopian conditions, nor do they imply new medical discoveries. . . . The hypothetical condition se-

* Irving Fisher, Bulletin 30, Report on National Vitality.

lected for the meaning of the term 'preventable' is contained in the following definition: a ratio of preventability is the fraction of all deaths which would be avoided if knowledge now existing among well-informed men in the medical profession were actually applied in a reasonable way and to a reasonable extent. The term 'reasonable' is of course elastic, and will be somewhat differently interpreted by different persons, but, as in law, where 'reasonable care' is often used as a proviso, it is impossible to make any more specific condition."

In regard to the collection and preparation of the information, we quote also: "The estimates of preventability . . . need special explanation. In a few cases, these estimates are based on statistical experience. The great majority of them are based on clinical experience merely, without any exact statistics. They are thus in the nature of expert guesses. The experts in all cases are physicians. . . . Those who gave to the construction of these estimates the benefit of their experience, observations and reading were especially asked above all to be conservative. In order to avoid any possibility of exaggeration of their estimates in the table their average was taken, and then the estimate entered as below the average given. When, as was true in a large proportion of cases, the different estimates agreed fairly well, the average was employed, or rather the nearest figure ending in 0, or 5 next below the average. If the individual estimates diverged widely, an estimate was used below the average, favoring the conservative estimates rather than the optimistic. Also in cases where only a few estimates were obtainable, the estimate as entered was put below the average of those given." Because of the conservative way in which the ratios were prepared we shall often find it convenient in the future to speak of the corresponding prevention of deaths as "reasonable" to distinguish it from another plan to be considered later.

The ratios of preventability are given in the following table:

TABLE I.*

SHOWING FISHER'S RATIOS OF PREVENTABILITY FOR THE DISEASES ENUMERATED IN THE MORTALITY STATISTICS OF THE UNITED STATES, TOGETHER WITH THE RELATIVE IMPORTANCE OF EACH DISEASE AS INDICATED BY THE PERCENTAGE THE NUMBER OF ITS DEATHS BEARS TO THE TOTAL NUMBER OF DEATHS.

	Causes of Death.	Prominence of Disease. Per Cent. of all Deaths.	Ratio of Preventability. Per Cent.
1	Premature birth	2.0	40
2	Congenital malformation of the heart	.55	0
3	Other congenital malformations	.3	0
4	Congenital debility	2.3	40
5	Hydrocephalus	.1	0
6	Venereal diseases	.3	70
7	Diarrhea and enteritis	7.74	60
8	Measles	.8	40
9	Acute bronchitis	1.1	30
10	Broncho-pneumonia	2.4	50
11	Whooping cough	.9	40
12	Croup	.3	75
13	Meningitis	1.6	70
14	Diseases of larynx—not laryngitis	.07	40
15	Laryngitis	.06	40
16	Diphtheria	1.4	70
17	Scarlet fever	.5	50
18	Diseases of lymphatics	.01	20
19	Tonsilitis	.05	45
20	Tetanus	.19	80
21	Tuberculosis—not of lungs	.17	75
22	Abscess	.08	60
23	Appendicitis	.7	50
24	Typhoid fever	2.0	85
25	Puerperal convulsions	.2	30
26	Puerperal septicemia	.4	85
27	Other diseases of childbirth	.36	50
28	Diseases of tubes	.1	65
29	Peritonitis	.5	55
30	Smallpox	.01	75
31	Tuberculosis of lungs	9.9	75
32	Violence	7.5	35
33	Malarial fever	.2	80
34	Septicemia	.3	40
35	Epilepsy	.29	0
36	General, ill-defined, and unknown causes (including "heart failure," "dropsy," and "convulsions")	9.2	30
37	Erysipelas	.3	60
38	Pneumonia (lobar and unqualified)	7.0	45
39	Acute nephritis	.6	30
40	Pleurisy	.27	55
41	Acute yellow atrophy of liver	.02	0
42	Obstructions of intestines	.6	25
43	Alcoholism	.4	85
44	Hemorrhage of lungs	.1	80
45	Diseases of the thyroid body	.02	10
46	Ovarian tumor	.07	0
47	Uterine tumor	.1	60
48	Rheumatism	.5	10
49	Gangrene of lungs	.03	0
50	Anemia, leukemia	.4	50
51	Chronic poisonings	.05	70
52	Congestion of lungs	.4	50
53	Ulcer of stomach	.2	50
54	Carbuncle	.03	50
55	Pericarditis	.1	10
56	Cancer of female congenital organs	.6	0
57	Dysentery	.5	80
58	Gastritis	.65	50
59	Cholera nostras	.09	50
60	Cirrhosis of liver	.9	60

* Fisher's Report, p. 104.

TABLE I—Continued.

	Cause of Death.	Prominence of Disease. Per Cent. of all Deaths.	Ratio of Preventability. Per Cent.
61	General paralysis of insane	.3	75
62	Hyatid tumors of liver	.002	75
63	Endocarditis	.8	25
64	Locomotor ataxia	.17	35
65	Diseases of veins	.04	40
66	Cancer of breast	.4	0
67	Diabetes	.8	10
68	Biliary calculi	.17	40
69	Hernia	.27	70
70	Cancer not specified	.9	0
71	Tumor	.08	0
72	Bright's disease	5.6	40
73	Embolism and thrombosis	.26	0
74	Cancer of intestines	.55	0
75	Cancer of stomach and liver	1.7	0
76	Calculi of urinary tract	.03	10
77	Cancer of mouth	.1	0
78	Heart disease	8.1	25
79	Influenza	.7	50
80	Asthma and emphysema	.23	30
81	Angina pectoris	.4	25
82	Apoplexy	4.4	35
83	Cancer of skin	.2	0
84	Chronic bronchitis	.8	30
85	Paralysis	1.0	50
86	Softening of brain	.2	0
87	Diseases of arteries	.83	10
88	Diseases of bladder	.2	45
89	Gangrene	.25	60
90	Old age	2.0	0

The area used as a basis of the investigation comprises the states Connecticut, Indiana, Maine, Massachusetts, Michigan, New Hampshire, New Jersey, New York, Rhode Island, Vermont, and the District of Columbia. These states, together with several cities in other states formed, in the years 1900–5, what is known as the "registration area." The essential and distinctive characteristic of the registration area is that its annual registration of deaths is regarded officially as having an error of less than 10 per cent. Additions have been made to this area since 1905 but it was thought best to limit the area under observation to the 11 registration states enumerated above, as these states were the only registration states to continue as such throughout the period considered—the 11 years 1900–10.

The plans for the construction of the mortality tables are merely plans for the computation of the corresponding death rates for each age. Once the death rates are computed, the rest of the mortality table is set up very easily.

The data necessary for this computation comprise the deaths for each year of age and the population at the beginning of that year.

The deaths are given directly in the government mortality statistics, but the population data given in the census reports do not pertain to the population at the beginning any more than they do at the end of the year. We usually assume the population data to refer to the population at the middle of the year and that to determine the population at the beginning of the year the ordinary population data must be increased by the number of deaths (usually one half of the total number) that have occurred since the beginning of the year.

The quotient of the deaths by the population at the beginning of the year for each age gives the death rate required. More refined methods would be necessary to compute death rates at ages in the neighborhood of the age of birth if much emphasis were to be placed upon the direct discussion of the several mortality tables, but as we are concerned here only with differences in corresponding results of two such tables, such methods are regarded as unnecessary.

From now on we shall often refer to those whose deaths are prevented as "restored" or as "restorations;" we shall refer also to those diseases which have the ratio "zero" in Table I as "unpreventable" instead of using the longer expression "diseases whose deaths are unpreventable."

The computation of the death rates of Table I which is based upon actual deaths is straightforward and involves no particular difficulty.

The plan for computing the death rates based upon mortality conditions wherein preventable deaths are prevented requires special explanation. As a concrete illustration, let us assume 1,000,000 persons to be living in a given community all at exactly the same age and that 50,000 of that number die during the succeeding year. We say that the death rate for that age is .05000. Assuming also that 5,000 of the 50,000 deaths are due, say to pneumonia, what would be the death rate for that age if 60 per cent., or 3,000 of the deaths due to pneumonia were prevented? In other words, how many deaths would now occur among the 1,000,000? Evidently,

the number of deaths would be 50,000 minus 3,000 plus whatever deaths would occur among the 3,000 restored, due to other diseases than pneumonia. The only way to determine how many deaths would occur among the restored is to assume the restored to be normal persons again and hence subject to ordinary diseases just as normal persons, in which case it is necessary merely to multiply the 3,000 by the probability of dying from the effects of diseases other than pneumonia. This probability is identically the death rate based upon the total number of actual deaths (as given by the government mortality statistics) diminished by the number of deaths due to pneumonia.

The method of computing death rates wherein the deaths from a large number of diseases are prevented, is exactly analogous to the above case of a single disease. The number of deaths that will occur among the restored is ascertained by multiplying the number of restored by the probability of dying from the effects of unpreventable diseases. We obtain this probability for each age by entering Fisher's table of ratios and ascertaining just what diseases are unpreventable at all (have the ratio "zero") and then divide the total number of deaths due to these diseases by the corresponding population.

If we let q'_x represent this probability or death rate based upon deaths due to unpreventable diseases, and r_x the number of restorations, the death rate for any age x, when preventable deaths are prevented, becomes

$$q_x = \frac{d_x - r_x + q'_x r_x}{l_x} = \frac{d_x - (1 - q'_x) r_x}{l_x} \qquad \text{(a)}$$

which, for the numerical example given above, becomes

$$q_x = \frac{50{,}000 - 3{,}000 + q'_x \cdot 3{,}000}{1{,}000{,}000} = \frac{50{,}000 - (1 - q'_x) 3{,}000}{1{,}000{,}000}$$

We have used the death rates represented by q'_x also to construct a third mortality table (Table III) whose use and importance will be explained later.

After the three sets of death rates were computed, the three mortality tables themselves were constructed in accordance with the definition of such a table, given previously.

The data used in this investigation comprise the deaths and population by ages for the area considered. In other words, the data comprise the essential material for computing the death rates for the different ages.

The population for 1900 of the 11 registration states enumerated above is given for each age, but, as is well known' there is a great concentration at ages which are a multiple of 5, particularly those ending in 0; so the data were first combined into quinquennial age groups and then the values for each age were interpolated. The population data for 1910 were available only in quinquennial age groups.

The different processes of interpolation used are described in the section devoted to the mathematical computation of the death rates.

The population data for the years 1900 and 1910 by quinquennial age groups are as follows:

TABLE II.

POPULATION BY AGE GROUPS FOR YEARS 1900 AND 1910 FOR ELEVEN REGISTRATION STATES.

Ages.	1900.	1910.	Ages.	1900.	1910.
0	437,944	508,815	40–44	1,247,880	[illegible]
0–4	2,072,797	2,407,441	45–49	1,018,403	1,334,080
5–9	1,984,846	2,192,716	50–54	872,741	1,153,970
10–14	1,819,115	2,112,774	55–59	685,460	831,227
15–19	1,804,950	2,216,868	60–64	562,777	672,462
20–24	1,906,779	2,354 725	65–74	702,679	864,675
25–29	1,839,826	2,203,961	75–84	263,124	314,857
30–34	1,630,050	1,948 886	85–94	30,647	50,504
35–39	1,474,697	1,831 043	95–	1,919	2,163

The deaths are given for the age groups 0, 1, 2, 3, 4, 5–9, 10–19, 20–29,—"90 and above," and are given by single and total years from 1900 to 1910 inclusive as follows:

TABLE III

DEATHS BY AGE GROUPS FOR EACH YEAR OF 1900–1910 AND THE TOTAL, FOR ELEVEN REGISTRATION STATES.

Years.	0	1.	2.	3.	4	5–9	10–19.	20–29
1900.	71,117	16,886	7,439	4,691	3.416	9,242	14,169	27,546
1901	62,759	14,389	6,333	4,136	3,159	8,535	13,354	26,853
1902	62,634	14,367	6,523	3,912	2,954	8,121	12,570	25,198
1903	60,751	13,422	6,115	3,936	2,747	8,422	13,325	25,686
1904	64,805	14,213	6,242	4,030	2,982	8,712	15,009	27,198
1905	66,894	13,806	6,073	3,757	2,66[illegible]	8,197	14,174	26,387
1906	70,750	15,416	6,513	3,990	2,816	7,938	13,860	26,188
1907.	68,962	14,114	6,057	3,801	2,755	7,788	14,002	26,576
1908	68,881	14,003	6,093	3.821	2,653	7,546	13,144	24,958
1909	67,081	14,870	6,208	3,717	2,679	7,412	12,[illegible]52	24,214
1910	72,096	15 041	6,643	4,084	2,785	7,972	13,320	25,874
Total	730,330	160,557	70,230	43,875	31,806	89,885	149,679	286,678

Years.	30–39.	40–49.	50–59	60–69	70–79	80–89	90– .
1900	28,322	2[illegible],152	30,987	37,556	38,631	21,471	3,424
1901	28,378	28,042	31,737	38,755	38,958	22,001	3,490
1902	27,0[illegible]5	26,707	30,236	36,[illegible]89	37,03[illegible]	20,147	3,247
1903	27,833	27,858	31,893	39 197	39,468	21,746	3,530
1904	29,935	29,773	33,939	42 [illegible]60	42,515	23,471	3,775
1905	29,209	29,959	33,356	42 [illegible]60	42 [illegible]25	23,009	3,619
1906	29.923	30,639	34,173	42,485	41,712	23,286	3.033
1907	31,343	32,569	36,637	45 983	45 751	25,727	3,950
1908	28,684	30,[illegible]65	35,151	43.530	43 062	24 124	3,878
1909	28.788	31,126	35,396	45,240	45,183	24.148	3,875
1910	30.[illegible]14	33 211	38,539	48,067	48,672	[illegible]6 175	4.223
Total	310,384	327,741	372,044	461,721	463,807	255,306	40,046

After the total deaths for each of the 145 diseases listed in the mortality statistics (by age groups) for all the area considered, and the 11 years 1900–10 were determined, these totals were multiplied by the appropriate ratios of preventability given by Professor Fisher, to obtain the number of deaths that are preventable. The following table gives the total number of preventable deaths:

TABLE IV

TOTAL NUMBER OF PREVENTABLE DEATHS FOR THE NUMBER OF YEARS AND AREA GIVEN

Ages.	Px	Ages	Px
0	312,743	30–39	[illegible]
1	83 [illegible]75	40–49	144 72[illegible]
2	41,467	50–59	[illegible]
3	23 438	60–69	[illegible]50 082
4	17 [illegible]41	70–79	102,301
5–9	46,658	80–89	[illegible]
10–19	79,35[illegible]	90–	9 32[illegible]
20–29	[illegible] 177		

The following table gives the total number of deaths due only to unpreventable diseases (those that have the ratio "zero" in Table I:

TABLE V.

DEATHS DUE TO DISEASES REGARDED AS ABSOLUTELY UNPREVENTABLE.

Ages.	Deaths.	Ages.	Deaths.
0	32,748	30–39	15,109
1	1,296	40–49	32,111
2	702	50–59	46,415
3	411	60–69	56,755
4	339	70–79	63,779
5–9	1,071	80–89	58,794
10–19	2,902	90–	16,845
20–29	6,311		

After the populations for 1900 and 1910, as given in Table II, were averaged, and this average multiplied by the number 11 (as explained later), the final data, also the totals of Table III and the data of Tables IV and V were expressed in quinquennial age groups (as explained later), as follows:

Age.	Table II.	Age.	Table III.	Table IV.	Table V.
0	5,206,075	0	730,330	312,742	32,748
0–4	24,641,309	1	160,557	83,175	1,296
5–9	22,976,586	2	70,220	41,467	702
10–14	21,625,390	3	43,875	23,438	411
15–19	22,119,099	4	31,606	17,041	339
20–24	23,432,772	5–9	89,885	46,658	1,071
25–29	22,240,829	10–14	51,197	24,753	1,356
30–34	19,664,148	15–19	98,482	54,597	1,546
35–39	18,161,570	20–24	132,783	74,806	2,388
40–44	15,400,737	25–29	153,945	85,372	3,925
45–49	12,856,047	30–34	157,125	82,914	5,942
50–54	11,036,911	35–39	162,259	90,988	9,167
55–59	8,287,378	40–44	160,579	73,965	14,098
60–64	6,793,930	45–49	167,162	70,756	18,013
65–69	5,182,683	50–54	177,648	68,224	21,606
70–74	3,457,764	55–59	194,396	70,015	24,747
75–79	2,497,494	60–64	225,175	78,004	27,292
80–84	1,081,642	65–69	236,546	80,996	29,463
85–89	410,827	70–74	244,698	86,492	31,762
90–94	84,454	75–79	218,909	75,809	33,017
95–	22,451	80–84	168,834	53,610	30,772
		85–89	88,472	19,891	28,022
		90–	40,646	9,320	16,845

We shall now show more in detail the methods used in computing the three sets of death rates for mortality Tables 1, 2, and 3.

In all three cases we averaged the data for the 11 years in order to obtain results based upon an average year. However,

this plan of averaging the data was carried out by assuming as our average year that one whose population and whose deaths were equal in number to the corresponding totals of the 11 years.

Since the population data are issued only once in 10 years, we assumed that the population increased in arithmetical progression from the year 1900 to the year 1910. That is, we averaged the populations for 1900 and 1910, and multiplied the average by 11 to obtain the population for the 11 years. Perhaps a more satisfactory plan would be to assume that the population increased in geometrical progression, but as we are not concerned with values given directly in the mortality tables but rather with differences of such values, the extra work required to carry through such a plan was considered unnecessary.

From the data given by age groups in Tables II, III, IV, and V, the population, deaths, and restorations for each age were obtained by methods of interpolation to be explained later; then the populations at the beginning of the year for each age were found in accordance with the explanation given above.

The death rates of Table 1, which is based upon actual deaths, were then found by dividing the number of deaths (given in Table III) by the population at the beginning of the year (obtained from the data of Table II), for each age.

The death rates of Table 3 which is based upon deaths due only to unpreventable diseases, were found by dividing the number of deaths due only to unpreventable diseases (given in Table V) by the same population which was used to compute the death rates of Table 1.

The death rates of Table 2 which is based upon deaths that would occur if unnecessary deaths were prevented, were found through the use of the formula

$$q_x = \frac{d_x - (1 - q_x')r_x}{l_x} \qquad \text{(a)}$$

given above, where d_x refers to the deaths of Table III, q_x the death rates of Table 3, r_x the restorations of Table IV

and l_x the populations which were used to compute the death rates of Tables 1 and 2, for the different ages.

TABLE 1.

MORTALITY TABLE BASED UPON THE ACTUAL DEATHS OF ELEVEN REGISTRATION STATES FOR THE YEARS 1900-1910.

Age.	l_x.	d_x.	q_x.	$\overset{\circ}{e}_x$.
0	125,326	16,831	.134380	49.44
1	108,494	3,431	31633	56.08
2	105,063	1,488	14165	56 84
3	103,575	933	9001	56 64
4	102,642	676	6585	56.16
5	101,966	543	.005327	55.61
6	101,423	454	4481	54.81
7	100,969	380	3757	54.06
8	100,589	318	3164	53 26
9	100,271	271	2706	52.43
10	100,000	241	.002407	51.57
11	99,759	223	2244	50.69
12	99,536	224	2246	49.80
13	99,312	233	2342	48.91
14	99,079	258	2606	48.03
15	98,821	343	.003469	47.15
16	98,478	404	4098	46.31
17	98,075	453	4616	45 50
18	97,622	478	4900	44 71
19	97,144	490	5039	43.93
20	96,654	505	005223	43.15
21	96,149	520	5408	42.37
22	95,629	536	5608	41 60
23	95,093	557	5860	40.83
24	94,536	581	6144	40 07
25	93 955	603	006415	39.31
26	93,352	624	6685	38 56
27	92,728	643	6935	37.82
28	92,085	659	7152	37.08
29	91,426	672	7347	36.34
30	90,754	686	.007554	35 61
31	90,068	700	7772	34 88
32	89,368	712	7980	34.15
33	88,655	724	8165	33 42
34	87,931	733	8351	32.69
35	87,198	741	.008501	31 96
36	86,457	750	8672	31 23
37	85,707	759	8861	30 50
38	84,948	772	9085	29 77
39	84,176	787	9350	29 06
40	83,389	803	009631	28 36
41	82,586	820	9930	27 67
42	81,766	841	10286	26 85
43	80 925	868	10727	26 12
44	80 057	899	11232	25 40
45	79 158	930	011748	24 68
46	78,228	972	12421	23 97
47	77 256	1,007	13034	23 26
48	76 249	1,033	13542	22.56
49	75 216	1,053	13995	21 87
50	74 163	1,075	.014501	21.17
51	73 088	1,096	15020	20 47
52	71 990	1,134	15745	19.78
53	70,856	1,190	16792	19 09
54	69 666	1,267	18191	18.40

Age.	l_x.	d_x.	q_x.	$\overset{\circ}{e}_x$.
55	68,399	1,350	.019730	17.74
56	67,049	1,443	21527	17.08
57	65,606	1,538	23436	16.43
58	64,068	1,617	25241	15.8[illegible]
59	62,451	1,682	26933	15.2[illegible]
60	60,769	1,746	.028730	14.6[illegible]
61	59,023	1,807	30616	14.0[illegible]
62	57,216	1,864	32575	13.4[illegible]
63	55,352	1,920	34740	12.9[illegible]
64	53,432	1,987	37198	12.3[illegible]
65	51,445	2,047	.039790	11.8[illegible]
66	49,398	2,102	42556	11.3[illegible]
67	47,296	2,161	45656	10.79
68	45,135	2,223	49240	10.3[illegible]
69	42,910	2,281	53151	9.77
70	40,629	2,330	057347	9.2[illegible]
71	38,299	2,339	61074	8.[illegible]
72	35,960	2,397	66668	8.[illegible]
73	33,563	2,415	71941	7.[illegible]
74	31,148	2,424	77817	7.[illegible]
75	28,724	2,426	084459	7.[illegible]
76	26,298	2,418	91945	6.7[illegible]
77	23,880	2,391	10010	6.3[illegible]
78	21,490	2,330	10844	5.[illegible]
79	19,160	2,241	11693	5 6[illegible]
80	16,919	2,138	12635	5.3[illegible]
81	14,781	2,021	13675	5.0[illegible]
82	12,760	1,888	14796	4.7[illegible]
83	10,872	1,741	16009	4.47
84	9,131	1,580	17303	4.2[illegible]
85	7,551	1,364	18067	4.0[illegible]
86	6,187	1,201	19412	3.79
87	4,986	1,037	20793	3.5[illegible]
88	3,949	879	22262	3.3[illegible]
89	3,070	728	23699	3.1[illegible]
90	2,342	578	24684	3.[illegible]
91	1,764	461	26134	2.[illegible]
92	1,303	360	27619	2.75
93	943	276	29138	2.61
94	668	206	30688	2.49
95	462	148	32360	2.3[illegible]
96	314	106	33956	2.2[illegible]
97	208	74	35479	2.12
98	134	50	37097	2.0[illegible]
99	84	33	38731	1.9[illegible]
100	51	21	40369	1.8[illegible]
101	30	13	42008	1 77
102	17	7	43686	1 74
103	10	5	45343	1 [illegible]
104	5	2	46839	1 70
105	3	1	48409	1 [illegible]
106	2	1	49940	1.[illegible]
107	1	1	51433	.50
108	0			

We shall now explain the methods of interpolation. As all the deaths are available in the age groups 0, 1, 2, 3, 4, 5-9,

10–19, 20–29,—"90 and above," and the population in the age groups 0, 0–4, 5–9, 10–14,—60–64, 65–74,—85–94, "95 and above," columns of T_x were formed in each case by successive additions of the numbers at the different ages, such that, T_x represents the total number at ages x and above. For example, in the case of the deaths, T_{40} means the total number of deaths at ages 40 and above. This change into columns of T_x is seen to be necessary from the character of the original data.

Ordinary fifth differences were used to interpolate single values to form quinquennial age groups out of the decennial age groups.

The four values of T_x within each quinquennial age group (except, of course, the two at each end) were interpolated by what is known as Sprague's osculatory method. This method is so well explained in so many places that we deem it sufficient to state merely that its use has the advantage over ordinary differences in that not only the slope but also the curvature of the curve (representing the values considered) at the points of intersection of the different partial interpolation curves is considered. As a result, the curve representing the completed series of values becomes much less undulating in form and hence more smooth throughout.

The final leading differences for interpolating four values between u_2 and u_3 of the series of equidistant values u_0, u_1, u_2, u_3, u_4, and u_5 are as follows:

$$(1) \quad \frac{\Delta u_0}{5} + 8\frac{\Delta^2 u_0}{5^2} + 11\frac{\Delta^3 u_0}{5^3} - 11\frac{\Delta^4 u_0}{5^4} + \frac{\Delta^5 u_0}{5^4}$$

(2)		1 "	+ 6 "	+ 1 "	+ 3 "
(3)			1 "	+ 4 "	− 3 "
(4)				1 "	− 2 "
(5)					5 "

TABLE 2.

MORTALITY TABLE SHOWING THE DEATH RATES AND EXPECTATIONS OF LIFE ASSUMING DEATHS TO BE PREVENTED ACCORDING TO THE RATIOS GIVEN IN TABLE 1.

Age.	l_x.	d_x.	q_x.	$\mathring{e}_x$.	Age.	l_x.	d_x.	q_x.	$\mathring{e}_x$
0	112,537	8,686	077169	63 11	55	81,945	1,033	012463	21.46
1	103,851	1,583	15346	66.36	56	80,912	1,198	13716	20.73
2	102,268	594	5023	66 28	57	79 714	1,197	15020	20.03
3	101,674	426	4183	65 67	58	78,517	1,278	16273	19 30
4	101 248	307	3035	64 94	59	77,239	1,348	17452	18 61
5	100 941	249	002459	64.13	60	75,891	1,419	018698	17.93
6	100,692	213	2116	63 27	61	74,472	1,489	19988	17.27
7	100 479	172	1619	62 42	62	72,983	1,557	21332	16.61
8	100 307	168	1678	61 54	63	71,426	1,630	22821	15 98
9	100 139	139	1386	60 62	64	69 796	1,709	24487	15.37
10	100 000	126	001259	59.72	65	68,087	1,788	026255	14.69
11	99 874	118	1186	58 79	66	66,299	1,866	28148	14.07
12	99 756	116	1167	57 86	67	64 433	1,947	30222	13.47
13	99,640	120	1203	56 90	68	62,486	2,028	32462	12.87
14	99,520	129	1292	56 00	69	60 458	2,107	34855	12.29
15	99,391	160	001610	55 07	70	58,351	2,184	037438	11.71
16	99 231	183	1849	54 16	71	56 167	2,228	39669	11.15
17	99,048	202	2043	53 26	72	53 939	2,330	43169	10.59
18	98,846	213	2151	52 36	73	51 609	2,407	46645	10.06
19	98 633	217	2206	51 48	74	49 202	2,491	50638	9.51
20	98,416	224	.002279	50 59	75	46 711	2,574	055109	8.99
21	98,192	231	2356	49 70	76	44,137	2,661	60294	8.49
22	97 961	240	2446	48 82	77	41,476	2,737	65981	8.00
23	97 721	250	2568	47 94	78	38,739	2,784	71872	7.53
24	97 471	262	2689	47 06	79	35 955	2,805	78006	7.07
25	97,209	274	002817	46 18	80	33,150	2,818	084998	6.63
26	96,935	286	2949	45 31	81	30,332	2,818	92901	6.20
27	96 649	298	3080	44 45	82	27,514	2,801	10179	5 78
28	96 351	309	3208	43 58	83	24,713	2 764	11184	5.38
29	96 042	321	3337	42 72	84	21,949	2,706	12238	4.99
30	95 721	333	003476	41 86	85	19 243	2,538	13192	4.62
31	95,388	346	3628	41 01	86	16 705	2,447	14650	4.28
32	95 042	359	3776	40 16	87	14,258	2,342	16427	3.95
33	94 683	370	3907	39 30	88	11 916	2,239	18792	3.66
34	94 313	380	4027	38 46	89	9,677	2,142	22218	3.37
35	93 933	390	004154	37 61	90	7,535	1,868	24684	3.08
36	93,543	401	4296	36 78	91	5,667	1,481	26184	2.90
37	93 142	413	4433	35 93	92	4,186	1,156	27619	2.76
38	92 729	427	4610	35 08	93	3,030	883	29138	2.61
39	92 302	445	4818	34 24	94	2,147	659	30686	2.48
40	91 857	460	.005007	33 40	95	1,488	480	32260	2.36
41	91 397	482	5277	32 57	96	1,008	341	33844	2.24
42	90 915	507	5574	31 74	97	667	237	35470	2.13
43	90 408	533	5897	30 91	98	430	160	37097	2.03
44	89,875	561	6247	30 09	99	270	105	38731	1.94
45	89 314	592	006633	29 28	100	165	67	40369	1.86
46	88 722	627	7068	28 47	101	98	41	42008	1.78
47	88 095	661	7507	27 67	102	57	25	43650	1.71
48	87 434	692	7914	26 87	103	32	14	45243	1.65
49	86 742	721	8306	26 09	104	18	8	46839	1.55
50	86 021	751	008734	25 30	105	10	5	48408	1.40
51	85 271	782	9171	24.52	106	5	2	49949	1.20
52	84 489	822	9728	23 74	107	3	2	51462	.83
53	83 667	876	10471	22 97	108	1	1	52912	.50
54	82,791	846	11481	22 21	109	0			

To apply this method of interpolation, the observed values of T_x are differenced, the differences divided by the appropriate power of 5 (or multiplied by the corresponding decimal)

as indicated above, and then the leading differences themselves formed in accordance with the above scheme.

The interpolated values of T_x for each interval are formed by the continued addition of the differences in the usual way, and there is a good check on the computation because the next higher quinquennial value of T_x given in the original or observed data must be reproduced at each stage.

Each quinquennial interval will have its own set of differences derived from the differences of an age ten years younger, but the easiest plan is to compute the successive fifth differences which by a continued addition to the lower differences of the preceding sub-interval (in each case) will lead to the desired interpolated values of the next interval. This plan avoids the separate computation of the leading differences for each interval to be interpolated.

The scheme of computing successive fifth differences has been suggested before but we were unable to find anywhere the formulas for computing these fifth differences, so we have derived them ourselves to be as follows:

$$4\,\Delta^5 + \Delta^6,\ -6\Delta^5,\ -6\,\Delta^5 - 6\Delta^6,\ 4\,\Delta^5 + 3\,\Delta^6,\ 5\,\Delta^5 + 5\Delta^6,$$

$$\text{where } \Delta^n = \frac{\Delta^n u_0.}{5^4}$$

After the interpolation itself is completed the subtraction of each value of T_x from the one at the age next below will give the desired column (of deaths or population) of values for each age.

As Sprague's method of interpolation requires two quinquennial periods on each side of the interval into which five sub-intervals are to be introduced, the interpolation at the ends of each set of data were performed by using ordinary third differences. For the inner of the two quinquennial periods at the ends of each set of data the interpolations were applied centrally. Thus the ordinates of the curve through the points $u_0.\ u_1$, u_2, and u_3 or

$$u_x = u_0 + x\Delta u_0 + \frac{x\,(x-1)}{2\,!}\,\Delta^2 u_0 + \frac{x\,(x-1)\,(x-2)}{3\,!}\,\Delta^3 u_0$$

for x = 5/5, 6/5—10/5 were differenced five times to form the

leading differences to interpolate four values between u_1 and u_2. The leading differences are as follows:

(1)	$\frac{\Delta u_0}{5} + 3\frac{\Delta^2 u_0}{5^-} - 4\frac{\Delta^3 u_0}{5^3}$
(2)	1 " $+ 1$ "
(3)	1 "
(4 and 5)	0

The ordinates of the same curve for $x = 0/5$—$1/5$, $5/5$ were differenced five times also to form the leading differences for interpolating four intermediate values in the outer quinquennial periods. Thus, these interpolations are not applied centrally. The leading differences are as follows:

(1)	$\frac{\Delta u_0}{5} - 2\frac{\Delta^2 u_0}{5^2} + 6\frac{\Delta^3 u_0}{5^3}$
(2)	1 " $- 4$ "
(3)	1 "
(4 and 5)	0

The main advantage in using the above tables of leading differences, besides convenience and system, is the accompanying check upon the accuracy of the computation, just as in the application of Sprague's method.

A very little investigation will reveal the fact that the part of the mortality table at and beyond age 90 is very flexible as far as the data are concerned, but that the difference in the expectation of life at birth on two plans, even though they differ widely, is insignificant, because at the ulterior end of the table we are dealing not only with very small populations in comparison with the radix (or population at the beginning of the table), but also with the difference of two such small populations.

This fact is very important, for we tested, in various ways the possibility of lengthening the mortality tables, and concluded in every case that any significant lengthening of the table would require quite unreasonable assumptions. For

example, an assumption that the death rate shall remain constantly equal to that of age 89 after that age, lengthens the table itself scarcely a year and has no significant effect upon the expectation of life. We wish to emphasize this fact in order to make it clear that we have no choice worth while in dealing with the ulterior end of the mortality table.

TABLE 3.

MORTALITY TABLE SHOWING MORTALITY CONDITIONS UNDER THE MORE EXTREME OF ASSUMPTIONS CONSIDERED IN THIS PAPER IN REGARD TO THE PREVENTION OF DEATHS.

Age.	l_x.	d_x.	q_x.	$\mathring{e}_x$.	Age.	l_x.	d_x.	q_x.	$\mathring{e}_x$.
0	100,778	696	.006906	84 89	55	97,260	248	.002553	31 69
1	100,082	29	294	84.40	56	97,012	273	2819	30.77
2	100,053	14	144	83 61	57	96,739	298	3079	29.86
3	100,039	8	85	82 62	58	96,441	319	3307	28.95
4	100,031	8	71	81.63	59	96,122	332	3461	28.04
5	100,023	4	000040	80 63	60	95,790	348	.003630	27.14
6	100,019	4	43	79.53	61	95,442	364	3811	26.23
7	100,015	4	47	78 54	62	95,078	393	4027	25.33
8	100,011	6	51	77 54	63	94,685	409	4314	24.43
9	100,005	5	54	76 54	64	94,286	440	4670	23.54
10	100,000	6	.000058	75 55	65	93,846	474	.005052	22 65
11	99,994	6	61	74 56	66	93,372	511	5472	21.76
12	99,988	6	64	73.56	67	92,861	552	5943	20 88
13	99,982	7	66	72 56	68	92,309	596	6457	20.00
14	99,975	7	67	71.57	69	91,713	644	7017	19 12
15	99,968	6	.000065	70.57	70	91,069	696	007646	18.25
16	99,962	7	66	69.58	71	90,373	744	8235	17.39
17	99,955	7	68	68.58	72	89,629	819	9139	16.53
18	99,948	7	72	67.59	73	88,810	895	11080	15.68
19	99,941	8	78	66 59	74	87,915	985	11207	14 83
20	99,933	8	.000084	65 60	75	86,930	1,089	.012528	14.00
21	99,925	9	91	64 60	76	85,841	1,214	14143	13.17
22	99,916	10	100	63 61	77	84,627	1,352	15978	12.35
23	99,906	11	111	62 61	78	83,275	1,502	18039	11.54
24	99,895	12	125	61 62	79	81,773	1,666	20370	10.74
25	99,883	14	.000140	60 63	80	80,107	1,859	.023208	9.96
26	99,869	16	158	59 63	81	78,248	2,087	26666	9.18
27	99,853	18	177	58 64	82	76,161	2,354	30906	8.42
28	99,835	20	196	57.66	83	73,807	2,671	36194	7.67
29	99,815	22	217	56.67	84	71 136	3,050	42877	6 94
30	99,793	24	.000242	55 68	85	68,086	3,379	.049624	6.23
31	99,769	27	272	54 69	86	64 707	3.923	60632	5 53
32	99,742	30	303	53 71	87	60,784	4,625	76086	4.86
33	99,712	33	336	52 72	88	56 159	5.600	99715	4 21
34	99,679	37	369	51.74	89	50.559	7,061	13966	3.62
35	99,642	40	.000406	50 76	90	43 498	9.573	.22008	3.15
36	99,602	44	443	49 78	91	33.925	8,866	26134	2.90
37	99,558	49	492	48 80	92	25,059	6,921	27619	2.75
38	99,509	56	560	47 82	93	18,138	5,285	29138	2 61
39	99,453	64	643	46 85	94	12,853	3 944	30686	2.48
40	99,389	73	.000732	45 88	95	8,909	2,874	32260	2.36
41	99,316	82	830	44 92	96	6,035	2,043	33856	2.24
42	99,234	92	927	43 95	97	3,992	1,416	35470	2.14
43	99,142	101	1018	42 99	98	2,576	956	37097	2.04
44	99,041	110	1106	42 04	99	1,620	627	38731	1.94
45	98,931	119	.001204	41 08	100	993	401	40369	1.85
46	98,812	129	1310	40.13	101	592	249	42003	1.77
47	98,683	140	1419	39 18	102	343	150	43630	1.70
48	98,543	150	1522	38.24	103	193	87	45243	1.62
49	98,393	160	1622	37 29	104	106	50	46839	1.55
50	98,233	169	.001725	36.36	105	56	27	48409	1.48
51	98 069	179	1826	35 42	106	29	14	49949	1.40
52	97,885	191	1949	34.48	107	15	8	51452	1 22
53	97 694	207	2116	33.56	108	7	4	52912	1.07
54	97,487	227	2324	32 62	109	3	2		.83
					110	1	1		.50

The tables were completed, however, for the purpose of computing the expectations of life at the earlier ages.

The death rates for Tables 2 and 3 are, of course, less than the corresponding rates for Table 1 below age 90, but the curves representing the rates for Tables 2 and 3 are much steeper at the higher ages than that of Table 1; hence, any effort to interpolate in the two tables beyond age 90 results in death rates greater instead of less than those found in the same way for Table 1, a result which, of course, is not tenable.

As the best estimate of the death rates at the extreme ages, we assumed the same values in Tables 2 and 3 as in Table 1. Any systematic effort to obtain values less than those thus chosen resulted in absurd values. For example, the assumption of a longer mortality table for Tables 2 and 3 than for Table 1 leads to intermediate values of the death rates in the neighborhood of age 90 and beyond, in excess of unity.

The tables of deaths and restorations afford abundant material for profitable discussion and therefore merit careful and intelligent interpretation. Most of such discussion, however important and valuable, would prove only distantly related to the purpose of this paper, and so must be passed over for the present. We shall enumerate a few of the most important facts which are closely related to the subject under consideration.

(a) A careful comparison of the number of deaths given in Table III* for each year shows that although mortality conditions on the whole are gradually improving from year to year, they are improving only because the decrease in the death rates at the ages preceding age 40, except at the age of birth, exceeds the increase at ages beyond age 40. In other words, while diseases operative at the younger ages are show-

*It should be kept in mind that the population increased about 20 per cent. from year 1900 to year 1910.

ing wonderful improvement, those operative at the more advanced ages are actually growing more destructive.

(b) Comparison of the number of restorations in Table IV with the total number of deaths of Table III indicates that most of the preventable diseases are operative principally at the earlier ages. In fact, many diseases were found, in connection with the preparation of Table IV, which showed improvement at the earlier ages and a deterioration at the more advanced ages. It is apparent that most attention has been paid by scientists to the ills and weaknesses of youth rather than those of the older ages.

(c) If we assume the ratios of preventable deaths to all deaths by ages, as indicated by Tables III and IV covering the area composed of the 11 registration states considered in this paper, to hold for the whole of the United States, we find that about 6,000,000 deaths out of a total of 14,000,000 deaths that occurred in the United States during the eleven years 1900–10, were wholly unnecessary.

It has been noted that relatively few deaths at the older ages are preventable; we believe, however, that if scientists could be made to realize fully the importance of improving mortality conditions at the higher ages, just as great an improvement is possible at these ages as is exhibited at present at the younger ages.

It is difficult to imagine what a tremendous advance would be made if death rates at the older ages could be made to decrease instead of being allowed to increase. In other words, if in estimating the annual change in mortality conditions, we were allowed to register an improvement at the older ages and hence add a measure of this improvement to the measure of improvement at the younger ages, instead of allowing the effects of an improvement at the younger ages to be canceled to a large extent by the effects of a deterioration at the older ages, the results would be marvelous.

We are compelled to deal, in this paper, wholly with losses due to preventable deaths that can be expressed statistically; perhaps the greatest loss of all is one which we have no way of measuring numerically, and that is the wealth of experience, knowledge, and general wisdom of older persons much

the greater part of which is lost at the present time through premature loss of memory, intellectual and physical weakness, and all other characteristics of premature old age.

Some of the greatest authorities on the diseases of mankind believe the *average* length of life should be from 75 to 200 years. If such should be the length of life, it is evident that much must be done that has not, as yet, even been attempted, and the present discussion should make it clear at what point the main attack should be directed—at the diseases of the older ages.

We have already stated that a mortality table expresses concisely and clearly the mortality conditions based upon circumstances wherein the corresponding death rates are known and are used to construct the given mortality table. We shall now compare the mortality tables, (a) Table 1, which is based upon deaths as they occur at present, and (b) Table 2, in which preventable deaths are assumed to have been prevented, to ascertain the vital losses that are due to the occurrence of preventable deaths.

We have brought together the death rates of Tables 1 and 2, in Table 4 for purposes of readier comparison. We have also added a column of corresponding differences of these death rates, and a column of the percentages of these differences of the death rates based on actual deaths.

If we keep in mind that the general death rate for this country is about 14 per 1,000, this fact will help us to understand more completely a discussion of the two sets of death rates.

The excess in death rates, given in Table 4, due to the occurrence of preventable deaths begins at the maximum value of 57 per 1,000 and decreases very abruptly by ages to about 3 per 1,000 at age 1 and then on to the minimum value of 1 per 1,000 at age 10; the excess then increases about 5 or 6 per 10,000 each 5 years until at age 50 the excess has accumulated to about 6 per 1,000, or almost one half the general death rate. After age 50, the excess in the death rate about doubles itself every 5 years to the end of the table.

The percentage of this excess of the existing death rate starts in at zero at the highest ages and increases gradually, as age decreases, through 30 per cent. at age 80, 35 per cent.

at age 65, 40 per cent. at age 50, to over 50 per cent. from age 35 down to age 15, being a little over 56 per cent. between ages 20 and 25. For all ages below age 15, the percentage adheres closely to 50 per cent.

TABLE 4

COMPARISON OF THE DEATH RATES UNDER THE TWO ASSUMPTIONS THAT DEATHS ARE AND ARE NOT PREVENTED ACCORDING TO THE RATIOS GIVEN IN TABLE I

Age	Deaths.			Per Cent	Age	Deaths.			Per Cent
	Prevented	Not Prevented	Difference			Prevented	Not Prevented	Difference	
(1)	(2)	(3)	(4)	(4)÷(3)	(1)	(2)	(3)	(4)	(4)÷(3)
0	077188	134300	057112	420	45	006[illegible]33	0[illegible]1748	005[illegible]15	437
1	[illegible]5240	31622	[illegible]	5[illegible]	46	7068	[illegible]2421	5353	432
2	5022	14165	9143	644	47	75[illegible]	[illegible]3034	5627	422
3	4[illegible]93	9001	4508	533	48	[illegible]914	[illegible]3543	5629	417
4	3035	6585	3[illegible]0	539	49	[illegible]	[illegible]3065	[illegible]	409
5	002459	005327	002[illegible]5	538	50	006[illegible]34	[illegible]45[illegible]1	005767	298
6	2115	4481	23[illegible]6	5[illegible]	51	[illegible]171	15020	5849	387
7	1819	3757	1[illegible]38	515	52	[illegible]528	15745	6[illegible]7	383
8	1575	3[illegible]64	158[illegible]	50[illegible]	53	104[illegible]1	16792	6321	378
9	1385	2706	1321	487	54	11431	18[illegible]1	6760	371
10	00125[illegible]	002407	001148	4[illegible]	55	01[illegible]473	01[illegible]3	007246	368
11	1186	2244	1058	472	56	137[illegible]4	21527	78[illegible]3	363
12	1167	2246	10[illegible]9	48[illegible]	57	15020	[illegible]3436	84[illegible]6	360
13	1202	2342	1[illegible]40	4[illegible]	58	16[illegible]72	2[illegible]241	[illegible]	356
14	1292	2605	1313	[illegible]03	59	17473	[illegible]329	[illegible]	352
15	0016[illegible]0	0034[illegible]	00[illegible]	[illegible]	60	018[illegible]08	[illegible]	01[illegible]631	350
16	184[illegible]	40[illegible]	224[illegible]	5[illegible]	61	[illegible]	[illegible]	[illegible]	347
17	2043	4[illegible]6	2[illegible]3	[illegible]	62	[illegible]	[illegible]	11343	345
18	2[illegible]1	4[illegible]00	2749	5[illegible]2	63	[illegible]1	[illegible]474[illegible]	[illegible]	344
19	2[illegible]	[illegible]	2834	5[illegible]	64	[illegible]	[illegible]	[illegible]	343
20	00[illegible]79	00[illegible]	002943	5[illegible]4	65	[illegible]	[illegible]	01[illegible]	340
21	2558	540[illegible]	[illegible]	5[illegible]4	66	[illegible]	[illegible]	14408	338
22	2445	5608	3165	564	67	[illegible]	[illegible]	[illegible]	338
23	2558	58[illegible]	3702	56[illegible]	68	[illegible]	[illegible]	[illegible]	341
24	2689	6144	345[illegible]	5[illegible]3	69	[illegible]	[illegible]	[illegible]	344
25	002817	0064[illegible]	00[illegible]598	560	70	[illegible]	[illegible]	[illegible]	347
26	2949	6[illegible]85	3[illegible]36	5[illegible]	71	[illegible]	[illegible]	[illegible]14[illegible]	350
27	3080	[illegible]3	38[illegible]5	[illegible]	72	[illegible]	[illegible]	274[illegible]	3[illegible]2
28	32[illegible]8	71[illegible]	[illegible]44	[illegible]	73	[illegible]	[illegible]7441	[illegible]	352
29	333	734[illegible]	411	[illegible]	74	[illegible]	[illegible]	[illegible]	350
30	00347[illegible]	00[illegible]1	0040[illegible]8	54[illegible]	75	[illegible]	[illegible]8446[illegible]	[illegible]3310	347
31	36[illegible]	[illegible]	4[illegible]44	[illegible]	76	[illegible]	[illegible]	[illegible]	344
32	3770	7984	4205	[illegible]	77	[illegible]	[illegible]	[illegible]	341
33	390[illegible]	81[illegible]	4[illegible]58	[illegible]	78	[illegible]	[illegible]	[illegible]	330
34	4027	83[illegible]	4[illegible]04	[illegible]	79	[illegible]	[illegible]	[illegible]	333
35	004[illegible]54	008[illegible]	004[illegible]34	51[illegible]	80	[illegible]	[illegible]	041382	3[illegible]8
36	4280	86[illegible]2	4[illegible]	50[illegible]	81	[illegible]	[illegible]	[illegible]	320
37	4433	88[illegible]	44[illegible]	5[illegible]	82	[illegible]	[illegible]	[illegible]	312
38	4610	9056	44[illegible]	4[illegible]	83	[illegible]	[illegible]	4[illegible]25	300
39	48[illegible]	[illegible]35	4[illegible]	4[illegible]	84	[illegible]	[illegible]	4974	287
40	00[illegible]007	00[illegible]	004[illegible]4	4[illegible]	85	[illegible]	[illegible]	[illegible]	269
41	6277	[illegible]630	46[illegible]3	4[illegible]	86	[illegible]	[illegible]	47[illegible]3	246
42	5574	10[illegible]88	4[illegible]14	4[illegible]	87	[illegible]	[illegible]	4[illegible]	210
43	5897	107[illegible]7	48[illegible]0	44	88	[illegible]	[illegible]	[illegible]347	156
44	6247	1[illegible]32	4[illegible]	44	89	[illegible]	[illegible]	[illegible]	62
					90	[illegible]	24[illegible]84	000000	000

The excess in death rates is the greatest at the age of birth, being over 57 per 1,000, or over four times the general death rate. The importance of the excess at this age is all the more enhanced by the fact that the population at this age is greater than for any other age in any community. Hence, the absolute loss in deaths at the age of birth is much greater than at any other age.

In examining the value of this excess in death rate at any age, the relative amount of population usually found at that age should be considered. For example, the excess in death rates at age 80 and beyond is 40 per 1,000 or greater, but the absolute loss measured in number of deaths is no wise as serious as this excess indicates, because the population at this age is always very small—a little over 6 per cent. of that at the age of birth in the United States.

We have constructed Table 5 giving approximate values of the losses in deaths for representative ages, together with corresponding approximate values of the excess in death rates, taken from Table 4. The populations for each age used to compute the losses in deaths are approximate values of those given in Table II. A comparison of these losses in deaths gives a good idea of the relative importance of the excess in death rates at each age.

TABLE 5.

Age.	Population 1910.	Loss in Death Rates, per 1,000.	Loss in Deaths.
0	500,000	57	29,013 (=509.57)
1	481,000	16	7,696
10	422,000	1	422
20	471,000	3	1,413
30	390,000	4	1,560
40	313,000	4½	1,409
50	227,000	5½	1,249
60	124,000	10	1,240
70	86,000	20	1,720
80	30,000	41	1,230

With the exception of the first ten years the absolute losses in deaths in Table 5 are remarkably alike in value for each age; the losses for the first ten years, however, begin with a loss in deaths at the age of birth of almost 25 times the average loss at any following age, and decrease through a relatively large loss at age 1, to the minimum value at age 10, which is only about one fourth that of any succeeding age.

We have brought together also the expectations of life of Tables 1 and 2 in Table 6 for purposes of comparison and discussion. A third column gives the corresponding differences in these expectations, expressed in years and days.

TABLE 6.

COMPLETE EXPECTATIONS OF LIFE AS BASED UPON THE TWO ASSUMPTIONS THAT DEATHS ARE AND ARE NOT PREVENTED ACCORDING TO THE RATIOS GIVEN IN TABLE I.

Age.	Deaths		Loss in		Age.	Deaths		Loss in	
	Not Prevented.	Prevented.	Years.	Days.		Not Prevented.	Prevented.	Years.	Days.
0	49.44	62.11	12	245	45	24.68	29.28	4	219
1	56.03	66.26	10	84	46	23.97	28.47	4	183
2	56.84	66.28	9	161	47	23.26	27.67	4	150
3	56.64	65.67	9	11	48	22.56	26.87	4	113
4	56.15	64.94	8	288	49	21.87	26.09	4	80
5	55.51	64.13	8	226	50	21.17	25.30	4	47
6	54.81	63.27	8	168	51	20.47	24.52	4	18
7	54.06	62.42	8	131	52	19.78	23.74	3	350
8	53.26	61.54	8	102	53	19.09	22.97	3	321
9	52.43	60.63	8	73	54	18.40	22.21	3	296
10	51.57	59.72	8	55	55	17.74	21.46	3	263
11	50.69	58.79	8	37	56	17.08	20.72	3	234
12	49.80	57.86	8	22	57	16.45	20.00	3	201
13	48.91	56.80	7	321	58	15.83	19.30	3	193
14	48.03	56.00	7	354	59	15.23	18.61	3	139
15	47.15	55.07	7	336	60	14.63	17.93	3	110
16	46.31	54.16	7	310	61	14.05	17.27	3	80
17	45.50	53.26	7	277	62	13.48	16.61	3	47
18	44.71	52.36	7	237	63	12.92	15.96	3	15
19	43.93	51.48	7	201	64	12.36	15.32	2	350
20	43.15	50.59	7	161	65	11.82	14.69	2	318
21	42.37	49.70	7	120	66	11.29	14.07	2	285
22	41.60	48.82	7	80	67	10.77	13.47	2	256
23	40.83	47.94	7	40	68	10.26	12.87	2	223
24	40.07	47.06	6	361	69	9.77	12.29	2	190
25	39.31	46.18	6	318	70	9.29	11.71	2	153
26	38.56	45.31	6	274	71	8.82	11.15	2	120
27	37.82	44.45	6	230	72	8.36	10.59	2	84
28	37.08	43.58	6	183	73	7.93	10.04	2	40
29	36.34	42.72	6	139	74	7.50	9.51	2	4
30	35.61	41.86	6	91	75	7.09	8.99	1	329
31	34.88	41.01	6	47	76	6.70	8.49	1	288
32	34.15	40.15	6	0	77	6.31	8.00	1	252
33	33.42	39.30	5	321	78	5.98	7.53	1	201
34	32.69	38.46	5	281	79	5.64	7.07	1	157
35	31.96	37.61	5	237	80	5.32	6.63	1	113
36	31.23	36.76	5	193	81	5.02	6.20	1	66
37	30.50	35.92	5	153	82	4.74	5.78	1	15
38	29.77	35.08	5	113	83	4.47	5.38		332
39	29.03	34.24	5	77	84	4.23	4.99		277
40	28.30	33.40	5	37	85	4.01	4.62		223
41	27.57	32.57	5	0	86	3.79	4.25		168
42	26.85	31.74	4	325	87	3.58	3.89		113
43	26.12	30.91	4	288	88	3.39	3.56		62
44	25.40	30.09	4	252	89	3.22	3.27		18
					90	3.06	3.06		0

According to Table 6, the expectation of life at age 10 is, at present, 51.57 years; the expectation of life at age 10 would be 59.72 years, or a little over 8 years more than it is at present, if unnecessary deaths were prevented.

The greatest difference, however, occurs at the age of birth where it is almost 13 years. In other words, the average length of life would be 62 years or 13 years longer than it is now if it were not for the occurrence of unnecessary deaths.

Professor Fisher obtains between 14.02 and 16.2 years by means of his short-cut method; hence, we are inclined to believe that his method gives somewhat exaggerated results as a rule. We have confirmed this belief in our own mind by other examples which, however, are in no other way related to the subject of this paper and are, therefore, not given here.

We have no criticism of Professor Fisher's results themselves when we consider the conservatism used in the preparation of his table of ratios. In fact, we shall point out later that this loss in expectation of life due to preventable deaths may well be much larger than his largest value of 16.2 years.

It should be emphasized that our estimate of 12.67 years as the loss in the average length of life, due to preventable deaths, does not refer to the average person irrespective of age, but only to those at the age of birth. Professor Fisher's estimate of from 14 to 16 years upon the whole of life is the only estimate he can make by his short-cut method, and it is very easy for the average person to fall into the error indicated. The loss at any age is significant enough, but by far the greatest loss is sustained at the age of birth.

On reference to Table 6, we notice that even at age 10 the loss in expectation of life is 8.15 years, or very little over 60 per cent. of the loss at the age of birth. At age 40, the loss is a little over 5 years, or about 40 per cent. of the loss at the age of birth. The loss at each age higher than age 10 is approximately 1 year less than the loss for age 10, for each succeeding ten years.

For purposes of comparison, attention is called to the fact that it has been estimated elsewhere by means of the methods used in this paper,* that the occurrence of deaths due to

* J. W. Glover, "The Monetary Loss in the United States due to Tuberculosis, based on the Returns of the Twelfth Census," *Transactions* of the Sixth International Congress on Tuberculosis, 1908.

tuberculosis causes a loss of about 2½ years in the expectation of life at age 20, or about one third the loss due to preventable deaths at the same age. However, this estimate is based upon the total number of deaths due to tuberculosis instead of just the preventable deaths due to that disease.

Similarly, the loss in the average length of life due to the total number of deaths due to typhoid fever has been estimated elsewhere to be about one half of one year, or about one twenty-fifth of the loss due to preventable deaths at the same age (age of birth).*

The important question naturally arises, would an assumed prevention of deaths less conservative in character than the one we have just considered lead to a little or to a much greater variation in estimates of vital losses due to preventable deaths? In other words, once we have actually decreased the number of annual deaths due to the different diseases to accord with Professor Fisher's ratios, have we accomplished all that is worth while, or have we merely begun? We shall attempt to answer these questions by the use of deductions made in connection with a discussion of Table 3.

It is to be remembered that Table 3 was constructed with death rates based upon deaths due only to unpreventable diseases. Thus, Table 3 reflects the mortality conditions of a community wherein occur no deaths due to diseases of which any percentage of deaths are at present preventable.

It is true that the assumption of such a community is too ideal to be realized for a long time in the future, but we believe this assumption can be replaced by others, less extreme in character, which would lead to results almost as remarkable. If Professor Fisher had tabulated the most radical or extreme estimates of the ratios of preventability that were given him, instead of the most conservative average of all, and if absolutely everything in the form of recent knowledge and discoveries in regard to diseases were used, we believe the results given in Table 3 would at least be approached very closely.

By the nature of the facts involved, it would be impossible to completely verify the above statement; the belief is based

* W. C. Mendenhall and Earl W. Castle, "Vital and Monetary Losses in the United States due to Typhoid Fever, QUARTERLY PUBLICATION OF THE AMERICAN STATISTICAL ASSOCIATION, June, 1911.

solely upon a personal survey of all the data used in the preparation of this paper and we shall not take the time or space to attempt to substantiate it.

In order that the main features of Table 3 might be more clearly and readily comprehended, we have brought together in Table 7 representative values of the death rates and expectations of life of both Tables 1 and 3. Columns of corresponding differences and percentages are added.

TABLE 7.

Age.	(Table 1).	(Table 3).	Differences.	Percentages.	(Table 1).	(Table 3).	Differences.	Percentages.
(1)	(2)	(3)	(4)	(4)÷(2)	(2)′	(3)′	(4)′	(4)÷(2)′
0............	.134300	.006908	.127392	95.1	49.44	84.89	35.45	71.8
10............	.002407	.000058	.002349	97.5	51.57	75.55	23.98	46.5
20............	.005222	.000084	.005138	98.4	43.15	65.60	22.45	52.0
30............	.007554	.000242	.007312	96.8	35.61	55.68	20.07	56.4
40............	.009631	.000732	.008899	92.4	28.30	45.88	17.58	62.1
50............	.014501	.001725	.012776	88.2	21.17	36.36	15.19	71.7
60............	.028729	.003630	.025099	87.5	14.63	27.14	12.51	85.7
70............	.057337	.007646	.049691	86.7	9.29	18.25	8.96	96.4
80............	.12638	.02321	.10317	82.0	5.32	9.96	4.64	87.2

It is not our purpose to discuss all the results indicated by Table 7, but merely to dwell briefly upon the most important results which will help us most to answer the questions raised at the beginning of this discussion.

According to Table 7, the average length of life should be about 85 years, or about 35½ years longer than it is at the present time; expressed differently, the average length of life should be about 70 per cent. longer than it is at present.

The expectation of life at age 10 should be about 76 years, or 24 years longer than it is at present.

We can now answer our very important questions by saying that the results given in Table 7 indicate that the results obtained by comparing Tables 1 and 2 are little more than marks of a beginning of what can be done in the way of improving general health conditions.

Such results at least suggest excellent goals toward which every effort should be made to advance; the results are certainly worthy of the greatest efforts.

MONETARY LOSSES.

Our discussion of monetary losses is based primarily upon the assumption that the average person contributes something to the wealth of the community about him during the most productive period of his life.

Although practically no one will object to the above assumption, there seems to be no satisfactory way of estimating the average value of this contribution. There are many who not only contribute nothing, but are even a heavy expense to their community all during their lives; there are others whose contribution is immeasurably great. There are some who, because of ill health or poverty, are prevented from adding to the wealth of their community except at particular intervals of the period throughout which the average person is considered most productive. Only a systematic investigation into these various sets of conditions would give us any satisfactory results, and such an investigation seems never to have been made.

Many have constructed schedules of values of this contribution by ages, which are intended to fit the average set of circumstances; the fact that these schedules fail to agree very closely indicates that they are not altogether satisfactory.

We make no attempt in this paper to decide rigidly what the value of this contribution should be assumed to be; instead, we assume a purely arbitrary value and then discuss certain monetary losses in terms of this value. Those who have decided views as to what the value of the contribution should be assumed to be can then modify the results in exactly the same proportion that their choice of this value differs from the value used here.

We shall assume that the average person contributes $100 annually to the wealth of the community about him between the ages 20 and 70. Hence, the death of such a person involves a loss equal to the present value of an annuity of $100 per annum at his age for the period ending with the age 70.

The present values of such annuities for each age from 20 to 70, interest at 5 per cent., based upon Tables 1 and 2, are given in the following table:

TABLE 9.

PRESENT VALUE, AT EACH AGE FROM 20 TO 70, COMPUTED WITH COMPOUND INTEREST AT 5 PER CENT., OF AN ANNUITY OR WEALTH INCREMENT OF $100 PER ANNUM AT THE END OF EACH YEAR, UNTIL AGE 70, ACCORDING TO TABLES 1 AND 2.

Age.	Deaths		Loss in Value.	Age.	Deaths		Loss in Value.
	Not Prevented.	Prevented.			Not Prevented.	Prevented.	
20	$1,601.00	$1,705.66	$104.66	45	$1,189.61	$1,274.46	$84.85
21	1,589.88	1,695.02	105.14	46	1,163.94	1,247.11	83.17
22	1,578.45	1,683.97	105.52	47	1,137.51	1,218.79	81.28
23	1,566.72	1,672.51	105.79	48	1,110.16	1,189.40	79.24
24	1,554.75	1,660.64	105.89	49	1,081.68	1,158.83	77.15
25	1,542.58	1,648.38	105.80	50	1,051.89	1,126.97	75.08
26	1,530.17	1,635.69	105.52	51	1,020.73	1,093.73	73.00
27	1,517.49	1,622.55	105.06	52	988.11	1,059.05	70.94
28	1,504.49	1,608.95	104.46	53	954.13	1,022.92	68.79
29	1,491.10	1,594.83	103.73	54	918.94	985.43	66.49
30	1,477.25	1,580.19	102.94	55	882.76	946.67	63.91
31	1,462.93	1,564.99	102.06	56	845.57	906.58	61.01
32	1,448.11	1,549.22	101.11	57	807.37	865.14	57.77
33	1,432.74	1,532.85	100.11	58	768.09	822.25	54.16
34	1,416.76	1,515.81	99.05	59	727.38	777.64	50.26
35	1,400.11	1,498.04	97.93	60	684.89	731.03	46.14
36	1,382.71	1,479.50	96.79	61	640.40	682.21	41.81
37	1,364.55	1,460.16	95.61	62	593.66	630.93	37.27
38	1,345.58	1,440.00	94.42	63	544.33	576.92	32.59
39	1,325.82	1,418.99	93.17	64	492.12	519.91	27.79
40	1,305.25	1,397.16	91.91	65	436.69	459.16	22.92
41	1,283.84	1,374.40	90.56	66	377.52	395.60	18.08
42	1,261.55	1,350.77	89.22	67	314.02	327.44	13.39
43	1,238.39	1,326.27	87.88	68	245.51	254.50	8.99
44	1,214.41	1,300.84	86.43	69	171.13	176.18	5.05

With these present values as a basis we could compute the present value of the total losses sustained throughout the United States, if the number of deaths by causes and by ages were known for the whole country. Less than one half of our states, however, keep anything like an accurate record of deaths each year.

If these statistics of deaths were known for the whole country, we could use Professor Fisher's table of ratios to determine the number of deaths at each age that are preventable; this number multiplied by the present value of the corresponding annuity would give us a measure of the monetary loss for that age, due to the occurrence of preventable deaths.

Since these statistics are not available for the whole country, we are compelled to use another method to determine the monetary losses due to deaths that are preventable. We shall make use of the population instead of the number of deaths to determine the losses under consideration, because the population of the whole country is given every 10 years by the census.

Just as the second column in Table 9 gives the present values of the future contributions, as computed by the use of Table 1, the third column gives the present values of the same future contributions, as computed by the use of Table 2 which is based upon mortality conditions which would exist if preventable deaths were prevented.

Referring to Table 9, we see that the value of the average person aged 20 to his community is $1,601.00, and that this value would be $1,705.66 if preventable deaths were prevented. Hence, such a community suffers a loss of $104.66 on every person living at the age 20, because of the occurrence of preventable deaths.

Column four of Table 9 gives values of these differences between the present values of persons for the different ages under the two sets of mortality conditions, which may therefore be regarded as measures of the effect of preventable deaths upon the value of persons to their community at different ages.

These differences, or "loss rates" increase slightly at first as age increases, due to the peculiar combination of the expectation of life and number of survivors of the mortality tables at these ages. After an interval of about ten years the loss rates start to diminish very gradually until about age 50 and then the decrease becomes more rapid toward zero.

Since we have a monetary measure of the effects of the occurrence of preventable deaths upon the value of each living person to his community, it remains merely to multiply the population of the United States for each age by the corresponding loss rate to determine the total losses at each age due to the occurrence of preventable deaths.

These populations for 1910 are given in Table 10 together with the corresponding loss rates, and finally the total losses

themselves. The population data were obtained in quinquennial age groups from the government mortality statistics, and the population for each age was determined by Sprague's method, discussed and used previously in this paper.

TABLE 10.

TABLE SHOWING THE PRESENT VALUE, COMPOUNDED ANNUALLY AT 5 PER CENT. OF THE LOSS DUE TO PREVENTABLE DEATHS, BASED UPON THE POPULATION OF THE UNITED STATES OF 1910, BOTH MALES AND FEMALES, FOR EACH AGE AND CERTAIN AGE GROUPS BETWEEN AGES 20 AND 70, ON THE BASIS OF AN ASSUMED PRODUCING CAPACITY OF $100 PER ANNUM UNTIL AGE 70.

Age.	Population, 1910.	Loss Rate.	Total Loss.	Age.	Population, 1910.	Loss Rate.	Total Loss.
20	1,829,028	104.66	$191,426,070	45	947,320	84.85	$80,380,102
21	1,834,552	105.14	192,884,797	46	915,046	83.17	76,104,376
22	1,827,619	105.52	192,850,357	47	887,879	81.28	72,166,805
23	1,802,149	105.79	190,649,343	48	867,715	79.24	68,757,737
24	1,763,636	105.89	186,751,416	49	851,237	77.15	65,672,935
20–24	9,056,984		954,561,983	20–49	40,336,056		3,960,550,043
25	1,725,192	105.80	182,525,314	50	835,069	75.08	62,696,230
26	1,686,044	105.52	177,911,363	51	822,047	73.00	60,009,431
27	1,641,354	105.06	173,340,651	52	796,738	70.94	56,520,594
28	1,590,635	104.46	166,157,732	53	751,796	68.79	51,716,047
29	1,536,778	103.73	159,409,982	54	695,151	66.49	46,220,590
20–29	17,236,987		1,813,907,025	20–54	44,236,847		4,237,612,935
30	1,481,263	102.94	152,481,213	55	641,014	63.91	40,967,205
31	1,421,512	102.06	145,079,515	56	585,274	61.01	35,707,567
32	1,375,605	101.11	139,087,422	57	541,109	57.77	31,259,867
33	1,351,976	100.11	135,346,317	58	516,108	54.16	27,952,409
34	1,341,829	99.05	132,908,162	59	503,446	50.26	25,303,196
20–34	24,209,172		2,517,809,654	20–59	47,023,798		4,397,803,179
35	1,329,384	97.93	130,186,575	60	488,856	46.14	22,555,816
36	1,319,524	96.79	127,716,728	61	475,366	41.81	19,875,052
37	1,297,068	95.61	124,012,671	62	458,783	37.27	17,098,842
38	1,253,418	94.42	118,347,728	63	435,645	32.59	14,197,671
39	1,196,706	93.17	111,497,098	64	408,500	27.79	11,352,215
20–39	30,605,272		3,128,570,454	20–64	49,290,948		4,482,882,775
40	1,143,469	91.91	105,096,236	65	383,517	22.92	8,790,210
41	1,090,171	90.56	98,725,886	66	359,649	18.08	6,502,454
42	1,043,061	89.22	93,061,902	67	335,775	13.39	4,496,027
43	1,006,836	87.88	88,480,748	68	312,015	8.99	2,805,015
44	978,050	86.43	84,532,862	69	288,547	5.05	1,457,162
20–44	35,866,859		3,597,468,088	20–69	50,970,451		4,505,933,543

As in the case of the loss rates, the total monetary losses for the different ages increase slightly at first as age increases from about $191,000,000 at age 20 to $193,000,000 at age 22, but begin to decrease a little earlier than the loss rates. At age 23 the loss is again approximately that at age 20; from age 23 on, the decrease in the values of the losses is very gradual to the end of the table.

Besides the total losses for each age, the losses for the accumulative age groups 20–24, 20–29,—20–69 are given.

The grand total, or the loss for the total ages 20–69 is $4,505,933,543. This amount may then be regarded as the total monetary loss in terms of the arbitrarily assumed contribution $100, sustained by this country because of the occurrence of unnecessary deaths.

Just as in Table 9, we have the present value, at each age, of the future contributions of $100 per annum, so we have in this grand total of $4,505,933,543 the present value of an annuity of $246,820,350 per annum to continue for 50 years, interest at 5 per cent. In other words, $246,820,350 may, in the same connection, be regarded as the total annual loss sustained in this country because of preventable deaths. Perhaps it will help to visualize the value of this annual loss to state that it is about one fourth the value of our annual wheat crop and between two and three times the value of our annual product of gold which is approximately one fifth of that of the world.

A comparison of the mortality tables in this article leads to the following conclusions.

The losses in death rates sustained by this country due to preventable deaths run from as low as 1 per 1,000 at age 10 to as high as 57 per 1,000 at the age of birth. Expressed in percentages, these losses run from 30 per cent. of the actual death rates, or less, at age 90 and above, to over 50 per cent. at age 35 and all ages below, being over 55 per cent. between ages 15 and 20.

The losses in expectation of life or average future life time are about 13 years on the whole of life, 5 years less than that at the age of 10, and approximately 1 year less than that for each succeeding ten years.

If we assume that every person contributes $100 annually to the wealth of the community about him during the most productive period of life, say from age 20 to age 70, we estimate the present value of the total future losses in this country to be about $4,500,000,000 and the annual loss to be about $250,000,000.

The estimates of corresponding monetary losses where a different value is assumed for the individual contribution are to be found by increasing or diminishing (as the case may be) the above values in the same proportion.

JOINT COMMITTEE ON STANDARDS FOR GRAPHIC PRESENTATION.

PRELIMINARY REPORT PUBLISHED FOR THE PURPOSE OF INVITING SUGGESTIONS FOR THE BENEFIT OF THE COMMITTEE.*

As a result of invitations extended by The American Society of Mechanical Engineers, a number of associations of national scope have appointed representatives on a Joint Committee on Standards for Graphic Presentation. Below are the names of the members of the committee and of the associations which have coöperated in its formation.

Willard C. Brinton, *Chairman*, American Society of Mechanical Engineers. 7 East 42d Street, New York City.

Leonard P. Ayres, *Secretary*, American Statistical Association. 130 East 22d Street, New York City.

N. A. Carle, American Institute of Electrical Engineers.

Robert E. Chaddock, American Association for the Advancement of Science.

Frederick A. Cleveland, American Academy of Political and Social Science.

H. E. Crampton, American Genetic Association.

Walter S. Gifford, American Economic Association.

J. Arthur Harris, American Society of Naturalists.

H. E. Hawkes, American Mathematical Society.

Joseph A. Hill, United States Census Bureau.

Henry D. Hubbard, United States Bureau of Standards.

Robert H. Montgomery, American Association of Public Accountants:

Henry H. Norris, Society for the Promotion of Engineering Education.

Alexander Smith, American Chemical Society.

Judd Stewart, American Institute of Mining Engineers.

Wendell M. Strong, Actuarial Society of America.

Edward L. Thorndike, American Psychological Association.

*Copies may be had from the American Society of Mechanical Engineers, 29 West 39th St., New York. Price, 10 cents. Discount on quantities.

The committee is making a study of the methods used in different fields of endeavor for presenting statistical and quantitative data in graphic form. * * * * If simple and convenient standards can be found and made generally known, there will be possible a more universal use of graphic methods with a consequent gain to mankind because of the greater speed and accuracy with which complex information may be imparted and interpreted.

THE FOLLOWING ARE SUGGESTIONS WHICH THE COMMITTEE HAS THUS FAR CONSIDERED AS REPRESENTING THE MORE GENERALLY APPLICABLE PRINCIPLES OF ELEMENTARY GRAPHIC PRESENTATION

1 The general arrangement of a diagram should proceed from left to right.

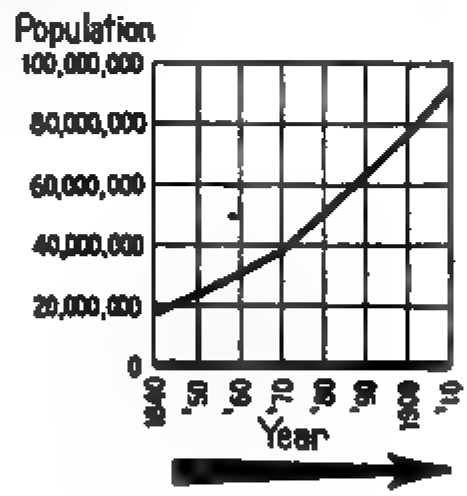


Fig. 1

Fig. 2

2 Where possible represent quantities by linear magnitudes as areas or volumes are more likely to be misinterpreted.

3 For a curve the vertical scale, whenever practicable, should be so selected that the zero line will appear on the diagram.

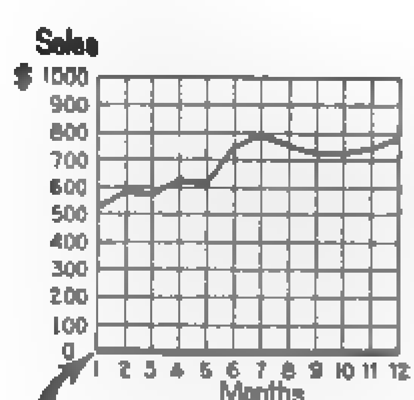


Fig. 3

4 If the zero line of the vertical scale will not normally appear on the curve diagram, the zero line should be shown by the use of a horizontal break in the diagram.

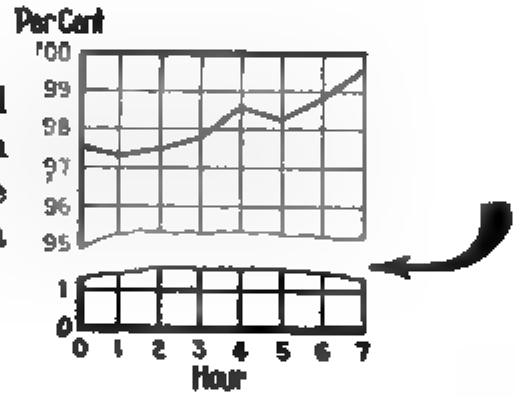


Fig. 4

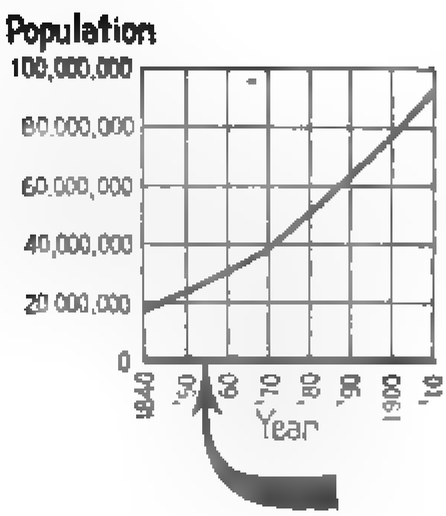


Fig. 5A

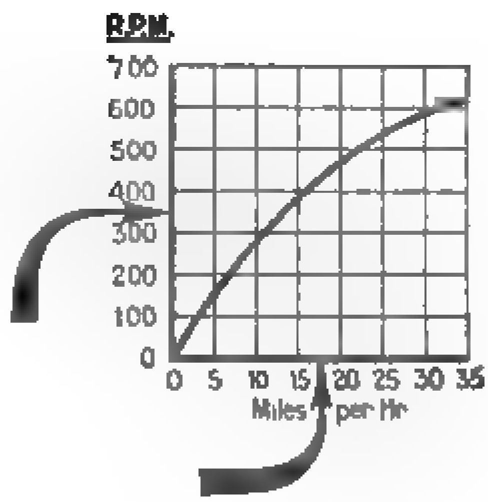


Fig. 5B

5 The zero lines of the scales for a curve should be sharply distinguished from the other coördinate lines.

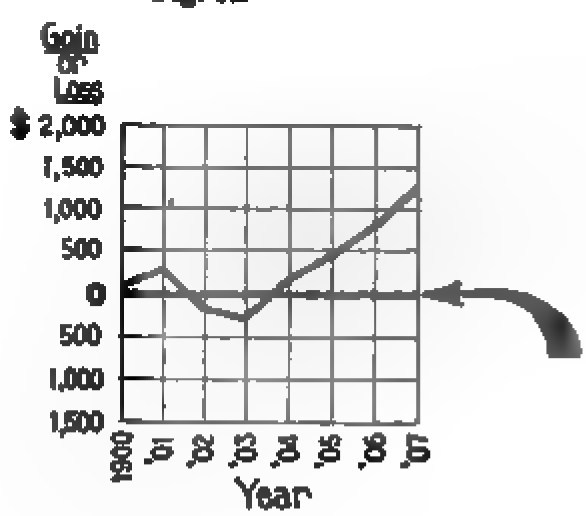


Fig. 5C

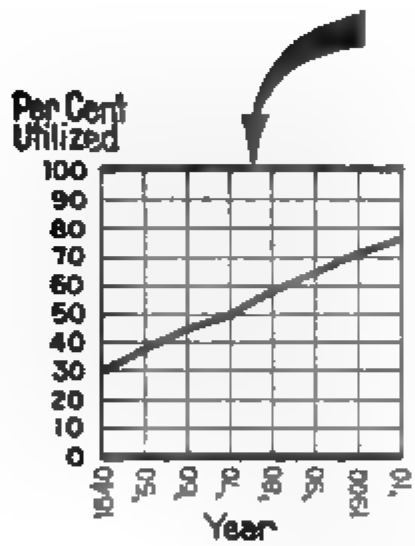


Fig. 6A

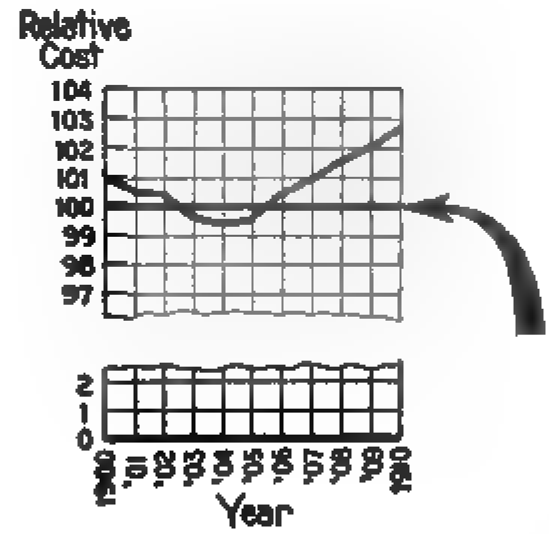


Fig. 6B

6 For curves having a scale representing percentages, it is usually desirable to emphasize in some distinctive way the 100 per cent line or other line used as a basis of comparison.

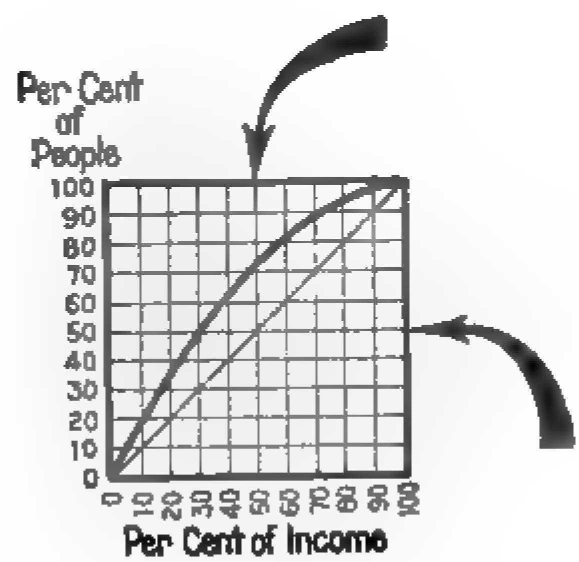


Fig. 6C

7 When the scale of a diagram refers to dates, and the period represented is not a complete unit, it is better not to emphasize the first and last ordinates, since such a diagram does not represent the beginning or end of time.

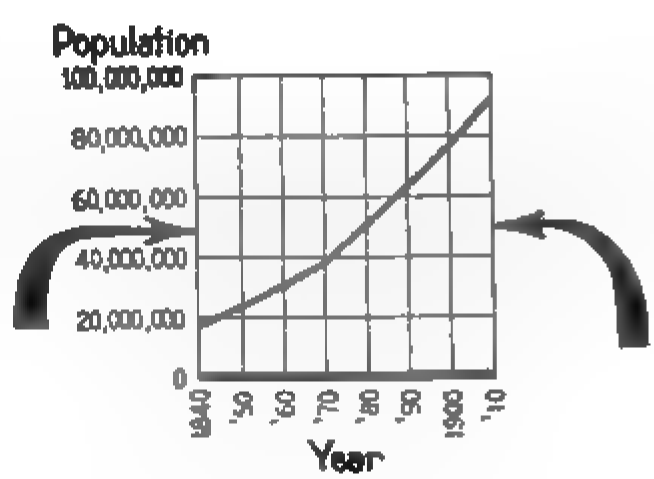


Fig. 7

8 When curves are drawn on logarithmic coördinates, the limiting lines of the diagram should each be at some power of ten on the logarithmic scales.

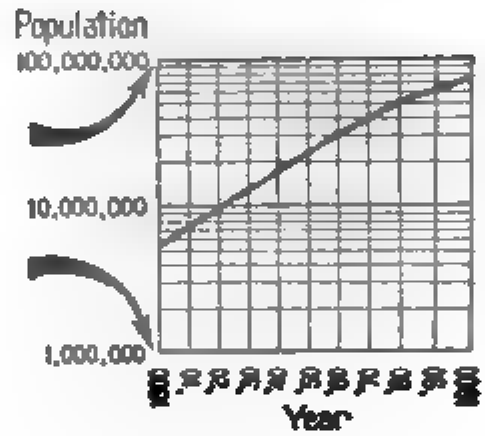


Fig. 8

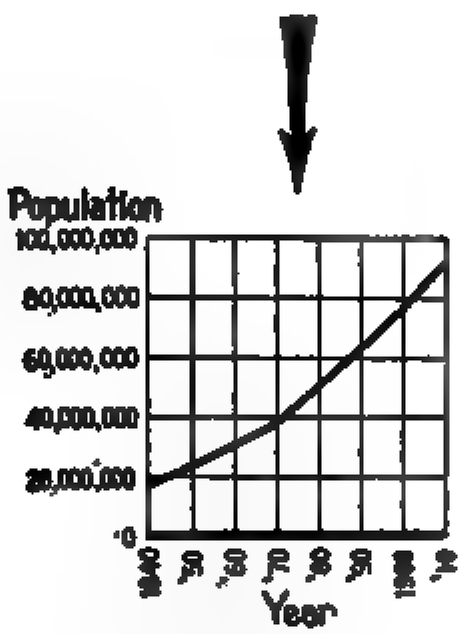


Fig. 9A

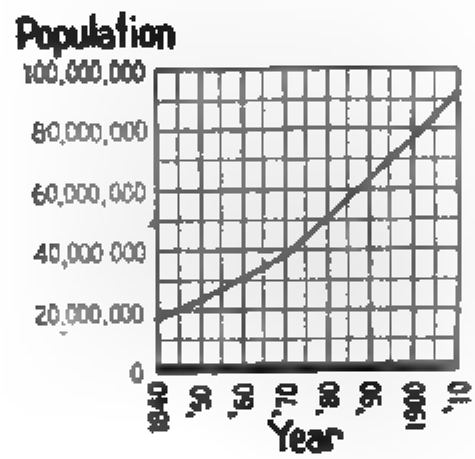


Fig. 9B

9 It is advisable not to show any more coördinate lines than necessary to guide the eye in reading the diagram.

10 The curve lines of a diagram should be sharply distinguished from the ruling.

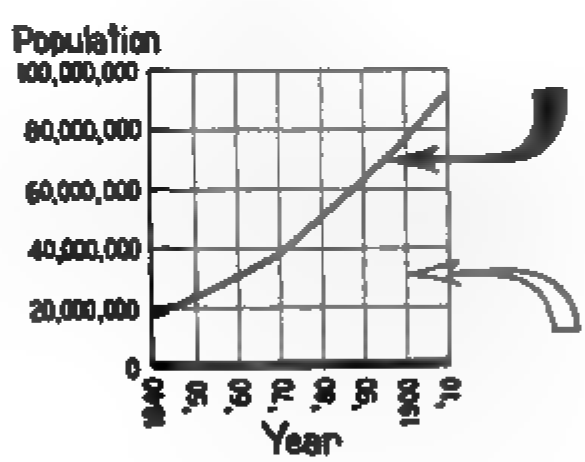


Fig. 10

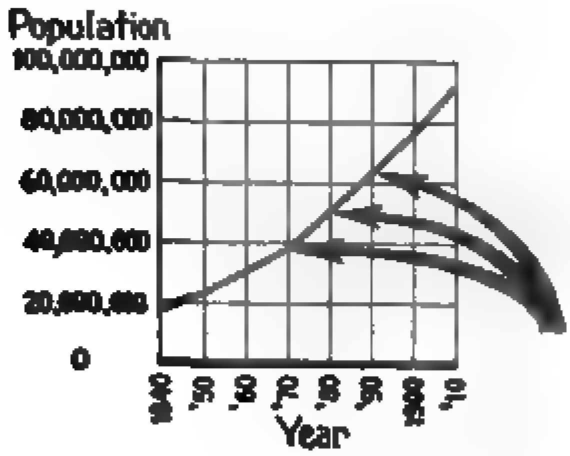


Fig. 11A

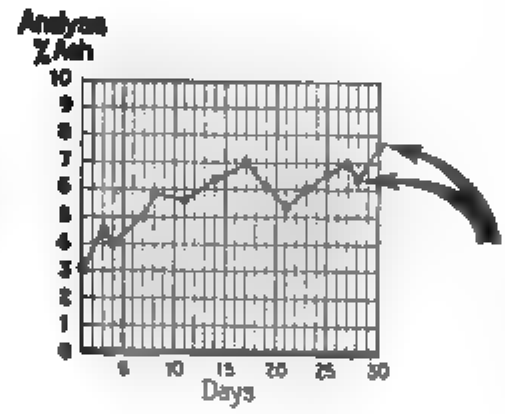


Fig. 11B

11 In curves representing a series of observations, it is advisable, whenever possible, to indicate clearly on the diagram all the points representing the separate observations.

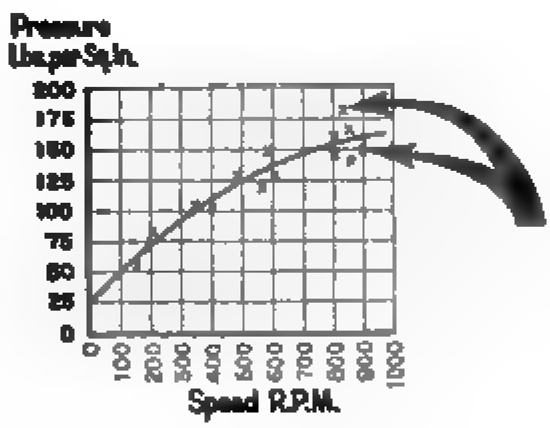


Fig. 11C

12 The horizontal scale for curves should usually read from left to right and the vertical scale from bottom to top.

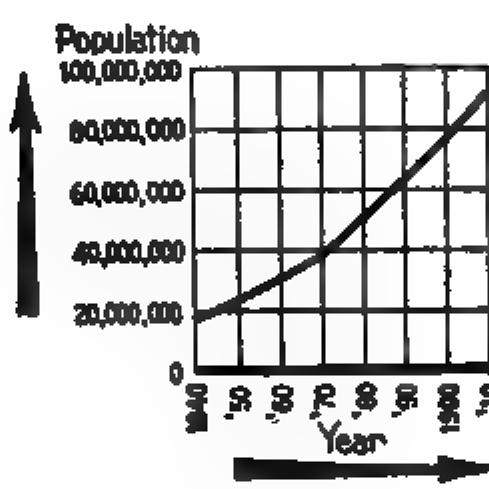


Fig. 12

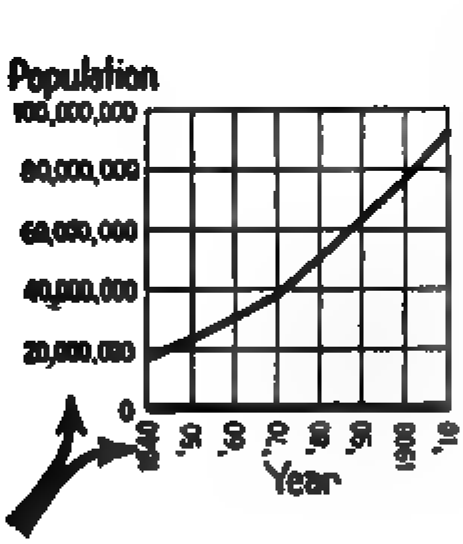


Fig. 13A

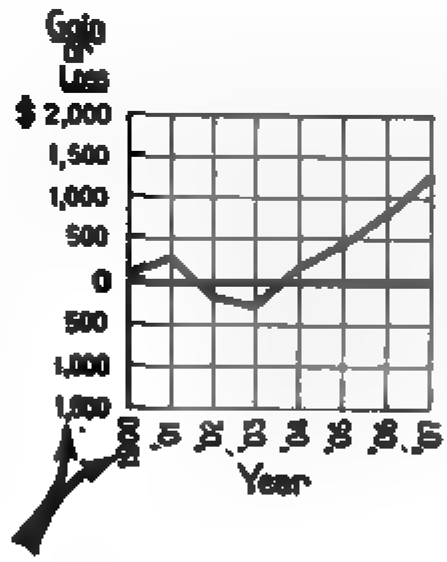


Fig. 13B

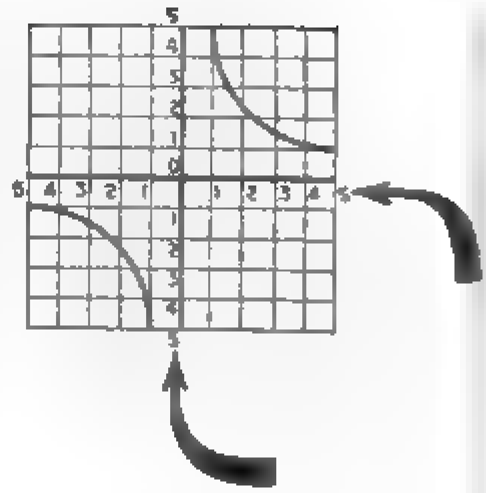


Fig. 13C

13 Figures for the scales of a diagram should be placed at the left and at the bottom or along the respective axes.

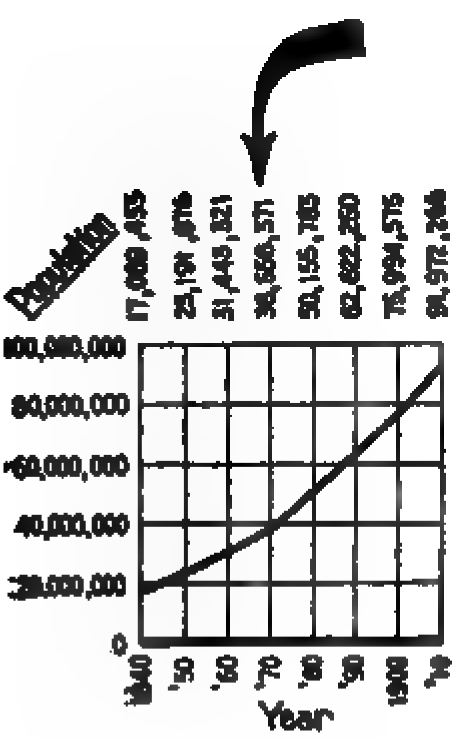


Fig. 14A

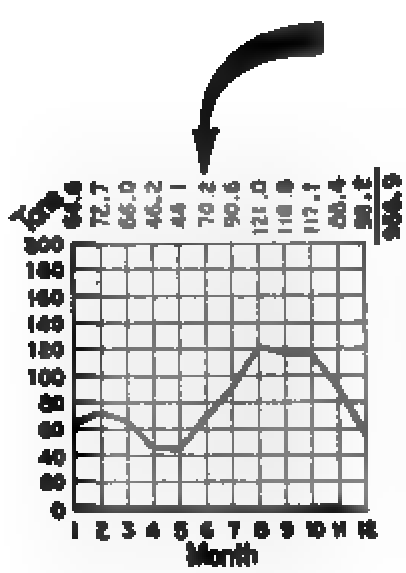


Fig. 14B

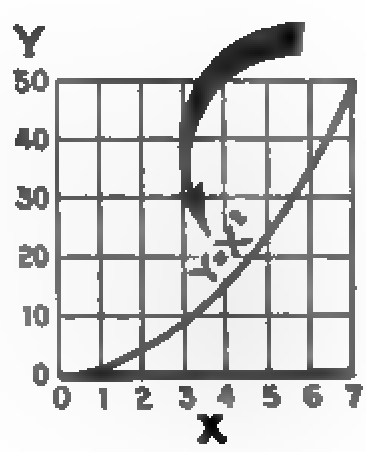
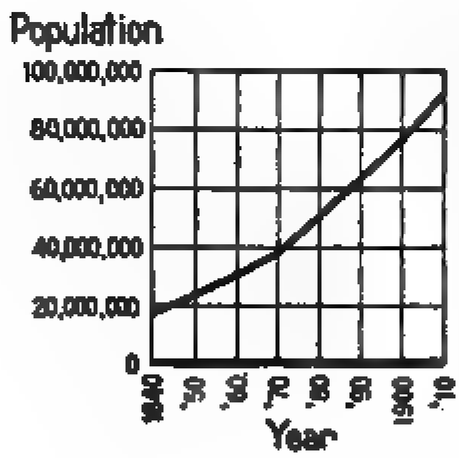


Fig. 14C

14 It is often desirable to include in the diagram the numerical data or formulae represented.

15 If numerical data are not included in the diagram it is desirable to give the data in tabular form accompanying the diagram.



Year	Populat on
1840	17,069,453
1850	23,191,876
1860	31,443,321
1870	38,558,371
1880	50,155,783
1890	62,622,250
1900	75,994,575
1910	91,972,266

Fig. 15

16 All lettering and all figures on a diagram should be placed so as to be easily read from the base as the bottom, or from the right-hand edge of the diagram as the bottom.

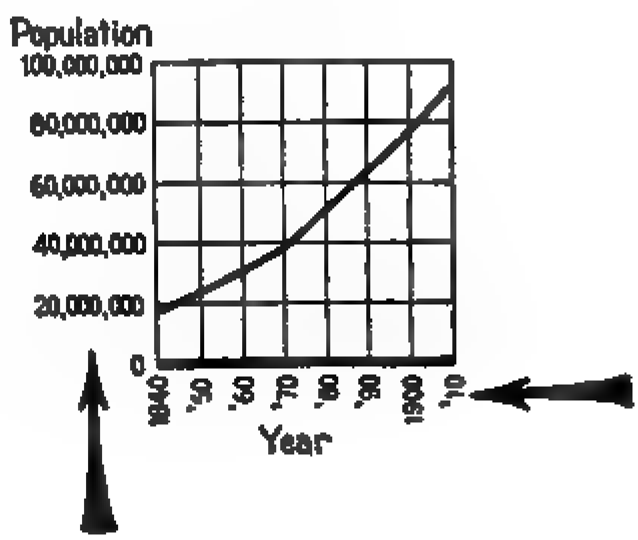
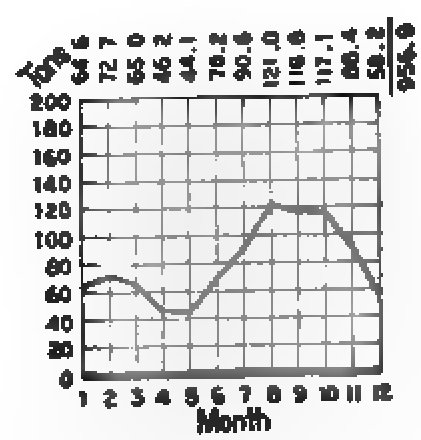


Fig 16

17 The title of a diagram should be made as clear and complete as possible. Sub-titles or descriptions should be added if necessary to insure clearness.



Aluminum Castings Output of Plant No. 2, by Months, 1914.

Output is given in short tons.

Sales of Scrap Aluminum are not included.

Fig. 17

NEW METHOD FOR COMPUTING THE MOVING AVERAGE.

By Willford I. King, Ph.D., *University of Wisconsin.*

Ability to readily use modern statistical methods has come to be an almost essential prerequisite to original research in the fields of economics and sociology. These sciences both deal largely with historical data. In studying the oscillations of historical variables it is nearly always necessary to compare them with some kind of a trend, and no other method of locating the trend is so generally applicable as the use of the moving average.

The usual methods of computing the moving average are satisfactory enough when the number of items in each group is small, but when a large group is used the labor involved becomes so great and the opportunities for error are so numerous that statisticians have been discouraged from employing this most useful tool. By the following method, the moving average can be computed with little extra work, even though the number of items in the group is largely increased. Each operation is checked for the detection of errors. An adding-machine is evidently a prime necessity if moving averages are to be calculated in this manner.

The method is believed to be original, though it is so simple that it is entirely possible that many other statisticians are in the habit of using it. The writer has found it convenient and practical and the students in his classes have had little difficulty in putting the device into practice.

Method for Computing the Moving Average.

1. Determine upon the correct number of items constituting one wave-length.

2. By aid of the adding-machine, summate the items constituting the first wave-length; *e. g.*, if there are seven items in one wave-length, add the first seven items, sub-totalling at the close. Continue adding, one by one, the succeeding items

of the variable, sub-totalling after *each* item is inserted. This is shown in Column I of the illustrative table.

3. Next, begin by inserting the first item of the variable in the adding-machine. Sub-total. Add the succeeding items of the variable, sub-totalling after *each* item. The spacing on the adding-machine slip must be identical with that obtained in the operation recorded in paragraph 2. The final result is illustrated in Column II.

4. Shift the second adding-machine slip downward until the first item thereon falls opposite the first item of the *second* wave-length in the first column. This is shown in Column II of the illustrative table where the *first* item is placed opposite the *eighth* item in Column I. With the adding-machine slips in this position, paste the second to the first.

5. At the head of a third column and directly to the right of its original position, enter the first sub-total of Column I. Now subtract each sub-total in the second column from the adjacent sub-total in the first column and enter the remainders immediately to the right in the third column. That part of Column II which extends below Column I is discarded.

6. Add each sub-total in Column II to the adjacent quantity in Column III. The sums, if correct, check with the sub-totals in Column I.

7. Divide each of the remainders in the third column by the number of items composing one group or wave. The quotients are the items of the moving-average. The date for the first of these items corresponds to the date of the middle item of the first wave-length in the original variable. For example, in Column I of the illustrative table, the date of the fourth or middle item of the first wave is 1893, which, therefore, is likewise the date of the first item in Column IV.

8. Check the mathematical accuracy of the last operation by summating Column IV, multiplying the sum by the number of items in one wave-length, and comparing with the sum of Column III. In case of discrepancy, the columns may be divided by horizontal lines into segments and each segment may be separately checked in the above manner until the location of the error is discovered.

AN ILLUSTRATION OF THE COMPUTATION OF A SEVEN-YEAR MOVING AVERAGE BY THE NEW PROCESS

Column I		Column II		Column III		Column IV
Pig Iron Production in the United States.		Pig Iron Production in the United States.		Column I—Column II		Moving Average.
Year.	Thousands of Tons.	Year.	Thousands of Tons.	Year.	Remainders.	Remainders ÷ Seven.
1890	*9,203*					
1891	*8,280*					
1892	*9,157*					
1893	*7,125*					
1894	*6,658*					
1895	*9,446*					
1896	*8,623*					
	58,492			1893	**58,492**	**8,356**
1897	*9,653*	1890	*9,203*			
	68,145		**9,203**	1894	**58,942**	**8,420**
1898	*11,774*	1891	*8,280*			
	79,919		**17,483**	1895	**62,436**	**8,919**
1899	*13,621*	1892	*9,157*			
	93,540		**26,640**	1896	**66,900**	**9,557**
1900	*13,789*	1893	*7,125*			
	107,329		**33,765**	1897	**73,564**	**10,509**
1901	*15,878*	1894	*6,658*			
	123,207		**40,423**	1898	**82,784**	**11,826**
1902	*17,821*	1895	*9,446*			
	141,028		**49,869**	1899	**91,159**	**13,023**
1903	*18,009*	1896	*8,6°3*			
	159,037		**58,492**	1900	**100,545**	**14,364**
1904	*16,497*	1897	*9,653*			
	175,534		**68,145**	1901	**107,389**	**15,341**
1905	*22,992*	1898	*11,774*			
	198,526		**79,919**	1902	**118,607**	**16,944**
1906	*25,307*	1899	*13,621*			
	223,833		**93,540**	1903	**130,293**	**18,613**
1907	*25,781*	1900	*13,789*			
	249,614		**107,329**	1904	**142,285**	**20,326**
1908	*15,936*	1901	*15,878*			
	265,550		**123,207**	1905	**142,343**	**20,335**
1909	*25,795*	1902	*17,821*			
	291,345		**141,028**	1906	**150,317**	**21,474**
1910	*27,304*	1903	*18,009*			
	318,649		**159,037**	1907	**159,612**	**22,802**
1911	*23,650*	1904	*16,497*			
	342,299		**175,534**	1908	**166,765**	**23,824**
1912	*29,727*	1905	*22,992*			
	372,026		**198,526**	1909	**173,500**	**24,786**
1913	*30,966*	1906	*25,307*			
	402,992		**223,833**	1910	**179,159**	**25,594**
1914	*23,332*	1907	*25,781*			
	426,324		**249,614**	1911	**176,710**	**25,244**
				Total ..	**2,241,902**	**320,257**

COMPARATIVE MILITARISM.

By Arthur MacDonald, *Anthropologist, Washington, D. C.*

One way to estimate militarism in a country is to give the number of soldiers and sailors (including officers) in time of peace, relative to the population, which is done in column 2 of the following table. The countries are arranged according to a descending scale of militarism, Roumania being highest, which is 15,700 soldiers and sailors per million population. United States is last having only 1,111 soldiers and sailors per million population. Sweden is second, having 15,299 soldiers and sailors per million population. France is third, having 14,874 per million population, but she is highest of all the larger nations in degree of militarism. Servia is fourth, Bulgaria fifth, and Turkey sixth. Germany is seventh, but of the larger nations she is second, being next to France in degree of militarism. Italy is eighth, Greece ninth, Austria-Hungary tenth, and so on down.

In some of the countries no trustworthy data as to sailors are obtainable, especially in the Balkan States, which, however, stand very high in militarism on land; they are rated without regard to their militarism on sea. If we compare the larger nations only, the order in degree of militarism (column 2) is France first, then Germany, Italy, Austria-Hungary, Russia, Great Britain, and the United States which is by far the least military of all.

In column 3, the figures are given for militarism on land only; the order is practically the same as in column 2 for both land and sea, except Great Britain, which is very low in militarism on land. In column 4, the figures are given for militarism on sea alone, the order being Great Britain first, then Sweden, Italy, France, Germany, Russia and so on. Great Britain's militarism on sea is more than three times as much as any other country; she is the only country having more sailors than soldiers. It will be found on the whole that militarism is according to geographical and political necessity.

In columns 5 and 6 are given the absolute numbers of soldiers and sailors (officers and men) in army and navy. The popular mind generally rates the militarism of a country according to the size of its army, which is incorrect, for the army might be large simply because the country is large; thus Russia has by far the largest army; so the United States, a non-military country, has a larger army than most of the Balkan States, which are bristling with militarism.

Also it would not do to estimate militarism according to amount of money paid out per capita of population (columns 7 and 8); for a country might have a much higher degree of militarism than it had money to carry it out; also larger and richer nations would have a high degree of militarism. Thus Great Britain's per capita rate for army and navy combined is the highest, making it most military of all, which is not true.

In column 9 is given the number of bordering nations for each country. Other things being equal, a nation having a large number of countries bordering upon it would be expected to have a larger army for its protection, especially if these other countries were first-class powers.

The true way, therefore, to estimate militarism, is according to the number of both soldiers and sailors, relative to population in times of peace.

COMPARATIVE MILITARISM.*

(Time of Peace.)

COUNTRIES 1911 (Population)	Number of Officers and Men per Million Population in both Army and Navy.	Number of Officers and Men per Million Population.		Absolute Number of Officers and Men.		Cost per Capita of Population.		Number of Bordering Countries
		Army.	Navy.	Army.	Navy.	Army.	Navy.	
1	2	3	4	5	6	7	8	9
Roumania...... (5,956,690)	15,700	15,700	—	98,139	—	$2.15	$—	4
Sweden......... (5,521,943)	15,299	14,400	899	79,603	4,965	2.43	0.95	2
France......... (39,601,509)	14,874	14,231	643	563,596	25,500	3.90	2.00	5
Servia......... (2,911,701)	12,220	12,220	—	35,605	—	1.47	—	6
Bulgaria........ (4,329,108)	11,041	11,041	—	57,800	—	1.83	—	3
Turkey........ (35,400,000)	10,593	10,593	—	375,000	—	1.00	—	5
Germany....... (64,903,423)	9,683	9,167	516	626,732	33,500	3.00	1.70	7
Italy.......... (34,686,683)	9,273	8,397	876	291,293	30,398	2.28	1.12	3
Greece......... (2,263,952)	8,966	8,966	—	23,600	—	1.40	—	1
Austria-Hungary (49,161,766)	8,359	8,057	302	396,114	14,888	1.90	0.20	7
Russia......... (118,690,600)	7,660	7,300	360	1,200,000	60,000	1.50	0.31	6
Great Britain ... (45,370,530)	6,963	2,953	4,010	134,000	181,939	2.50	4.50	0
Belgium........ (7,516,730)	6,100	6,100	—	46,574	—	1.74	—	3
Netherlands..... (5,945,155)	6,012	5,830	182	34,662	10,822	2.00	—	2
United States... (91,972,266)	1,111	982	91	91,783	12,032	1.00	1.35	2

* The figures in this table are based upon official data. Blanks indicate that reliable data were not obtainable.

WHOLESALE PRICES FOR THE UNITED STATES, 1801–1840.

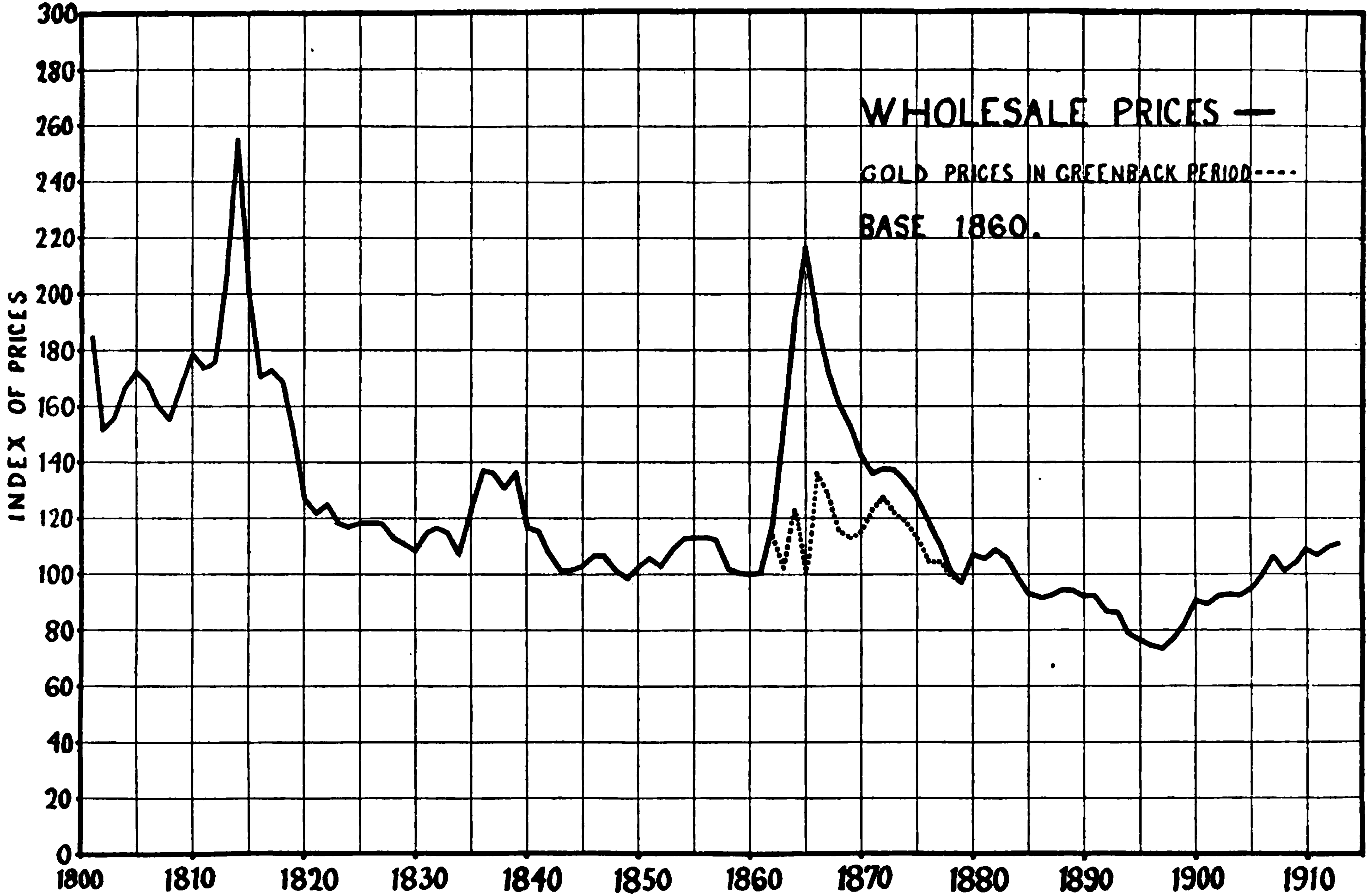
BY ALVIN H. HANSEN.

There has not been, so far as the writer is aware, any study of prices for the United States prior to 1825, and very little prior to 1840. Since the trend of prices is a subject of great interest and importance in the study of American social and economic movements, this investigation has been undertaken in order to construct a curve of prices for the United States extending back to the beginning of the last century.

The price curve shown in the accompanying chart is a composite of three separate index series all having been reduced to the common base 1860. The first period, 1801–1840, was worked up by the writer, the price average for the year 1825 being taken as the original base. The figures for the period 1840–1891 are the simple average index numbers prepared for the Aldrich Report by Roland P. Falkner, 1860 being the base. For the period 1891–1913 the Bureau of Labor index numbers were used, based 1890–9.

The numbers for the period 1801–1840 were derived from two distinct series, both having the year 1825 as the base. The index numbers for 1801–1825 were derived from the monthly quotations of wholesale prices of 79 commodities quoted in the Boston *Gazette* 1801–1815, and in the Boston *Patriot* 1816–1825. The index numbers for 1825–1840 are based on the monthly quotations of New York wholesale prices of 63 commodities quoted in the Report of the Secretary of the Treasury for 1863. Where various grades of unimportant articles were quoted, only one was used. When a range of a higher and lower price was shown in the quotations, the mean or average price was found. The average annual price for each commodity was obtained by adding the monthly quotations, taken for the first of the month or as close thereto as possible, and dividing the sum by the number of months. In some cases it was not possible to get quotations for each month. No quotations at all could be secured for 1809. For

PRICE INDEX FOR THE UNITED STATES



1825–1840 the yearly averages quoted in the Report of the Secretary of the Treasury were used.

Index numbers were worked out for each separate commodity, the price for 1825 being used as the base for both periods under consideration. That is to say, the average annual price for each year was reduced to a percentage of the average price for 1825. In the case of each commodity the same grade was used throughout, with the exception of iron. In this case "pig iron" was used for 1801–1808, "Philadelphia bar" for 1808–1815, and "Russia" for 1815–1825. The two latter sold at very nearly the same price, so "Russia" was simply substituted for "Philadelphia bar." The prices of these two and that of pig iron were, however, so different that they had to be adjusted. It was assumed that the index numbers of pig iron would indicate in general the trend of prices of "Philadelphia bar" and "Russia." The annual prices of pig iron were therefore reduced to index numbers on the base 1808, and the prices of "Philadelphia bar" and "Russia" were reduced to index numbers on the base 1825. The index number of the latter variety in 1808 was 111.9, while that of pig iron would be 100.0. Each of the index numbers of pig iron back to 1801 was, therefore, multiplied by 111.9 in order to show the general trend of iron prices in the entire period. In the case of the other 78 commodities used for the period 1801–1825, it was possible to carry through the same grade throughout. The attempt was made to carry through 84 commodities, but it was found necessary to throw out 5, because of changes in the quality of the commodity quoted. The same grade was quoted for the 63 commodities used for the period 1825–1840.

The index numbers thus obtained for the different commodities were then summated, and divided by the total number of commodities quoted for that year. The result would be the simple average index number of the prices of all commodities for the given year. Since both periods in question, 1801–1825, and 1825–1840, had the common base, 1825, it is evident that the relative prices of the entire period would thus be established.

The number of months for which quotations were given, and

the number of commodities quoted for each year were as follows:

Source of Information.	Year.	Number of Months for which Quotations were Obtained.	Number of Commodities Quoted.
Boston *Patriot* and Boston *Gazette*.			
	1801	12	75
	1802	12	77
	1803	12	79
	1804	12	79
	1805	12	79
	1805	12	79
	1806	12	79
	1807	7	79
	1808	9	78
	1809	0	0
	1810	12	78
	1811	12	78
	1812	11	78
	1813	11	78
	1814	2	54
	1815	11	78
	1816	7	78
	1817	12	78
	1818	8	79
	1819	11	79
	1820	12	78
	1821	6	78
	1822	12	79
	1823	12	79
	1824	12	79
	1825	12	79
Report of Secretary of Treasury.			
	1825	12	61
	1826	12	62
	1827	12	63
	1828	12	63
	1829	12	63
	1830	12	63
	1831	12	63
	1832	12	63
	1833	12	63
	1834	12	63
	1835	12	63
	1836	12	63
	1837	12	63
	1838	12	62
	1839	12	62
	1840	12	61

The index numbers from 1801 to 1840 are therefore based on the average prices, derived from the monthly quotations, for each year. This method is similar to that employed by the Bureau of Labor in its index, which is also based on the yearly averages of monthly quotations, except in the case of a few of the more unstable commodities, in which cases weekly quotations are used. The Aldrich index numbers, on the other

hand, were based on the actual prices of a given date, January 1, April 1, July 1, or October 1 of a given year. Usually the index numbers were calculated on the basis of January prices in each year, except in the case of commodities for which the January prices would not be the representative prices for the year, as in the case of certain vegetables. In such cases the most representative month was chosen. In a few cases, however, the average prices for the year were used.

The original index numbers, on the base 1825, for the period 1801–1840 were as follows:

1801	155.5	1821	102.3
1802	127.7	1822	105.3
1803	131.2	1823	100.1
1804	140.6	1824	98.9
1805	144.9	1825	100.0
1806	141.6	1826	99.4
1807	134.3	1827	99.6
1808	131.0	1828	95.2
1809	No data	1829	94.1
1810	150.4	1830	91.4
1811	145.7	1831	96.7
1812	148.1	1832	98.1
1813	172.4	1833	96.8
1814	214.8	1834	90.1
1815	168.6	1835	103.8
1816	143.6	1836	115.7
1817	145.4	1837	114.7
1818	141.5	1838	110.2
1819	124.7	1839	115.2
1820	106.9	1840	98.3

In order to get a continuous price curve for the United States for the entire century, the above index was connected up with the Aldrich index. It is recognized that this does not in any way represent an accurate extension of the Aldrich index, since the number and grade of commodities used in the two cases are not identical, and the methods of computation are somewhat different. Nevertheless, such a curve does indicate approximately the general trend of prices.

The method used in connecting up the above index with the Aldrich index was as follows: The relative price, or the index number, for 1840, as shown in the Aldrich Report, was used as the medium through which to compute the index numbers for all the years back to 1801. It was assumed that, had the base been 1860 instead of 1825, the index numbers for the period 1801–1840 would have stood in 1840 at the same relative price level as the index number of the Aldrich Report for the same year. The Aldrich index number for the year 1840

is 116.8. The above index number for 1840 is 98.3. Hence every unit in the above index series was multiplied by $\frac{116.8}{98.3}$ or 1.188. The product would approximately show the relation of the general level of prices of the given year to that of 1860, the year chosen as the base for the Aldrich index.

The following is a table showing the commodities used for the period 1801–1825, 1825–1840, and for 1840, the first year of the Aldrich series. It should be added that the number of commodities used in the Aldrich Report increases from 90 in 1840 to 223 in 1891.

This study of prices in the period 1801–1840 does not purport to be anything more than a tentative beginning. However, as the followin table indicates, the variety and number of commodities used is fairly comparable with those used in the Aldrich Report for the first years. The index numbers are based on the average prices of 12 monthly quotations for each year, in so far as they could be obtained, while the Aldrich numbers are based in general on January prices alone. The Aldrich Report has the advantage of using the price quotations of several cities. Quotations from say Boston, Philadelphia, Charleston, and New Orleans would undoubtedly have been very desirable for our period, particularly because of the greater diversity of wholesale prices then obtaining in different sections of the country, due chiefly to slow and inadequate means of transportation. Such a task would be far too great for one person to undertake.

COMPARATIVE TABLE OF COMMODITIES USED.

Boston *Gazette* and Boston *Patriot*. 1801–1825	Report of Secretary of Treasury. 1825–1840.	Aldrich Report. 1840.
Flour, fine	Flour, wheat, sup.	
	Flour, rye, fine	Flour, rye
Corn meal, kiln dried	Corn meal, northern	Corn meal, kiln dried
Barley	Wheat, Genesee	
Rye	Rye, northern	
Oats	Oats, northern	
Corn, Indian, northern	Corn, northern	
Bread, ship		Ship biscuits
		Boston crackers (2 kinds)
Rice	Rice, ordinary	Rice
Beans, white		
Starch, American		
	Cod, dry	
Mackerel, bay	Mackerel, No. 1.	Mackerel (3 kinds).
Pork, Cargo No. 1.	Pork, mess	Pork, salt mess
	Pork, prime	
Beef, mess	Beef, mess	Beef, salt mess
	Beef, prime	
Bacon		Bacon, clear
	Hams, smoked	Ham, sugar-cured
Tallow, American	Tallow, American	Tallow
Lard, hog's	Lard	Lard (2 kinds)
Butter, 1st quality	Butter	Butter
Cheese, American	Cheese	Cheese
Raisins, bloom	Raisins	Raisins
Figs, cask	Figs, Smyrna	
Lemons	Prunes, Bordeaux	
Currants		Currants
Almonds, soft shelled		
Coffee, ordinary	Coffee, Java	Coffee, Rio, fair
Tea, Hyson	Tea, Young Hyson	
Molasses, Havana	Molasses, Havana	Molasses (2 kinds)
Sugar, Havanna, white	Sugar, New Orleans	Sugar (3 kinds)
Sugar, Havanna, brown	Sugar, loaf	
Hops	Hops, first sort	
Salt, Liverpool	Salt, Liverpool, fine	Salt (5 kinds)
Pepper	Pepper	Pepper
Nutmegs	Nutmegs	Nutmegs
Cinnamon		
Cloves		
Ginger, ground		
Pimento		
Nankins		
Cotton, Georgia, upland	Cotton, upland	Cotton, upland
		Broadcloths
		Calico
	Wool, common	
	Wool, Merino	
	Wool, Pulled, No. 1.	
Hides, dried	Hides, La Plata	Hides
Leather, foal, dried	Leather, Hemlock	Leather
	Furs, Beaver, Northern	Sole leather
Copper, in sheets	Copper, sheeting	Copper, sheet
		Copper, ingot
Iron, pig, Phil bar, and Russia	Iron, English bar	Iron, rods
Lead, bar	Lead, pig	Lead, pig (2 kinds)
Steel		
Shot		Drop shot, lead
Nails		Nails, cut
Tin, in sheets		Zinc, sheet
Cordage, American		Rope (2 kinds)
		Wood screws
		Spelter
		Quicksilver

COMPARATIVE TABLE OF COMMODITIES USED—(Concluded).

Boston *Gazette* and Boston *Patriot*. 1801-1825.	Report of Secretary of Treasury. 1825-1840.	Aldrich Report. 1840.
Lumber, boards, clear		Lumber, hemlock
		Boards (4 kinds)
		Shingles (3 kinds)
Wood, mahogany, bay		Flooring
Varnish, white		
Lime		Lime
Glue, American		
Tar		Tar
Turpentine	Turpentine	Turpentine
Pitch		
Rosin	Rosin, common	
	Glass, American	Glass, window
Staves, W. Oak, pipe		
Hoops		
Copperas		Copperas
Brimstone		Brimstone, crude
Alum		Alum, lump, crystal
Gunpowder, American	Gunpowder, American	
Oil, linseed	Oil, whale	Oil, linseed
Pot ashes		Soda ash
Flaxseed		Flaxseed
Salt petre, rough		
		Calomel
		Mercury
		Muriatic acid
		Opium
		Quinine
		Sugar of lead (2 kinds)
		Sulphuric acid
		Blue vitriol
Candles, tall. mo. Am.	Candles, mould	
Coal, pit, American	Coal Schuylkill	
Sheeting, Russia	Sheeting, Russia, brown	
Soap, castile	Soap, castile	Soap, castile
Tobacco, James River	Tobacco Kentucky	
	Tobacco, mfg. No. 1.	
	Whiskey, domestic	Alcohol
	Brandy, Cognac	
	Rum, Jamaica	
	Gin, Scheidan	
Wine, Madeira	Wine, Madeira	
	Wine, Port	
Whalebone, long	Whalebone, slab	
Corks, Lisbon		
Bees wax		
Hemp		
Twine, sewing		
	Olives	
	Paint, red lead	
	Linseed	
	Indigo, Manillo	
		Matches
		Tubs, wooden
		Pails, wooden
		Carpets
		Tickings
		Carbonate of lead
		Putty
		Doors, pine

It should be noted that the prices used in this study are wholesale prices quoted necessarily in United States money. The retail prices of local mercantile establishments often

varied greatly according to the depreciation of the bank notes presented in payment for the goods. This was particularly true in 1814, when banks generally, except in New England, suspended specie payments. Since the value of the depreciated bank notes ranged all the way from par to almost nothing, it is evident that local retail prices might be almost anything, depending on the currency used. Thus, in the war period, retail prices elsewhere soared much higher than in New England where they remained on a specie basis. But it is evident that this fact would have nothing to do with the real level of prices quoted in United States money.

The question of the causes underlying the price curve presented herewith, is not here entered into. The period is complicated by a number of factors, principally the Berlin and Milan Decrees; the Orders in Council; the Embargo Act; the War of 1812; the great growth of state banks between the termination of the first United States Bank in 1811 and the establishment of the second United States Bank in 1816, tending to raise prices by increasing the amount of currency in circulation; the bank crash in New England in 1809; the crises of 1814, 1819, 1825, and 1837; and the monetary measures of the Jackson and Van Buren administrations.

THE PRESENT POSITION OF INFANT MORTALITY: ITS RECENT DECLINE IN THE UNITED STATES.

By Henry Horace Hibbs, Jr., *Sometime Fellow in Research, Boston School for Social Workers.*

The term infant mortality, according to the generally accepted usage, is employed to designate the deaths of infants under one year of age. The problem is measured by an infant mortality rate which is an expression of the proportion of infants dying under one year of age to 1,000 births or, when birth statistics are not available, to 1,000 population under one year of age. The deaths of infants at this early age is made the object of special study because they constitute such an enormous proportion of the deaths at all ages. In no other period of life do deaths occur with such frequency. This is evident upon examination of any of the bulletins on mortality statistics issued annually by the Bureau of the Census for the registration area of the United States. Thus, Bulletin 109 shows that 27 per cent. of the total number of deaths which occurred in the registration area in 1910 were of children under five years of age and 19 per cent., or almost one fifth, were of infants under one year of age. In 1911, 1912, and 1913 the deaths of infants constituted 18 per cent. of the deaths at all ages.

That the death rate for infants and young children should be greater than for other persons is not, however, surprising. As a recent English writer says, "The young of all animals are more susceptible than the adult to the influence of the environment and the approach of death. Hence, it is inevitable that, even under the most favourable circumstances the deaths of infants will furnish a large contribution to the bills of mortality."* It is not the mere fact of excess but the tremendously greater excess of deaths which occur during the first year of life that constitutes the problem of infant mortality.

Infant Mortality in Foreign Countries. The world-wide significance of the problem will be evident upon examination

* George Newman, M.D.: Infant Mortality. London, 1906, p. v.

of the following figures showing the infant mortality rate per 1,000 births for the foreign countries for which statistics are available during the five year period from 1906 to 1910:*

Chile	315	Finland	117
Hungary	204	Switzerland	115
Jamaica	191	The Netherlands	114
Ceylon	189	Scotland	112
Prussia	168	Denmark	108
Servia	154	Ireland	94
Italy	153	Sweden	78
Belgium	141	Australian Commonwealth	78
Ontario	127	Norway	70
France	126	New Zealand	70
England and Wales	117		

Thus, in one third of the countries of the world for which statistics are available the infant mortality rate was over 150, while in about one half it was over 125. In only 5 of the countries, 3 in Europe and 2 in Australasia, was the rate less than 100 deaths per 1,000 births. Expressed in another way this means that, out of every 1,000 children born in countries like Hungary, Prussia, and Italy, from 150 to 200 die before reaching the end of the first year of life; out of every 1,000 born in countries like England, Scotland, Switzerland, and The Netherlands, from 110 to 120 die before reaching this age; while in countries like Ireland, Sweden, Norway, and Australia, from 70 to 100 die before they are a year old.

Infant Mortality in the United States. Figures comparable with these exist for only a few of the states and cities of the United States. In 1911 the Bureau of the Census reported that only in the cities of Washington and New York and in the states of Pennsylvania and Michigan and the six New England States could the registration of both births and deaths be regarded as sufficiently complete (amounting to at least 90 per cent. of the total) to make possible the calculation of an accurate rate of infant mortality based on the ratio of births to deaths. This area comprises the provisional "registration

* Seventy Third and Seventy Fourth Annual Reports of the Registrar General for Births, Deaths, and Marriages in England and Wales (pp. xciv and 105–15 respectively).

area" of the United States for births and deaths. The infant mortality rates per 1,000 births for these states and cities in 1910 were as follows:

Rhode Island.....	158	Connecticut......	127
New Hampshire...	146	Michigan........	124
Pennsylvania.....	140		
Maine...........	135	Washington, D. C.	152
Massachusetts....	131	New York, N. Y..	125

Besides these states and cities where the registration of both births and deaths are regarded by the census office as being sufficiently or "fairly complete," there are others where the registration of deaths only is regarded as sufficiently complete to be included in what is known as the registration area for deaths. In 1910, 22 entire states and a large number of cities in non-registration states were included in this area. Since complete birth statistics are not available, it is not possible to calculate an infant mortality rate for this area in the ordinary manner—by computing the ratio of deaths to 1,000 births. To overcome this difficulty, the Bureau of the Census in its report on mortality statistics for 1910 employed an infant death rate based on the proportion of deaths to 1,000 population under one year of age in 1910. This method is confessedly inaccurate because the enumeration of the population under one year of age is never complete and entirely accurate. Yet it is the best method available for studying the distribution of infant mortality in the United States and, although its crudities should serve as a caution against drawing too fine conclusions from its use, its defects should not be over-emphasized. The following table shows the death rate per 1,000 population under one year of age for the registration states:*

Utah	82.3	Ohio.........	115.9
Washington	84.3	Michigan	127.5
Kentucky......	87.9	Maine	140.4
Montana.......	90.4	New York.....	143.6
California......	92.2	Connecticut ...	143.7
Minnesota......	92.4	New Jersey....	148.8

* Bureau of the Census: Bulletin 112, p. 24.

Missouri.......	*96.7	Pennsylvania..	149.7
Colorado.......	104.5	Maryland.....	152.1
Indiana........	106.9	Massachusetts.	160.8
Wisconsin......	108.0	New Hampshire	164.9
Vermont.......	109.4	Rhode Island..	181.5

Thus the infant death rate per 1,000 population varied from less than 85 in the Western states, Utah and Washington, to 165 and 182 in the two New England states, Rhode Island and New Hampshire. It was 127.6 for the entire group of registration states considered as a whole.

It would be of interest to compare the rates for this group of states with those for foreign countries given in a previous table. But this is, of course, impossible since infant death rates based on population can not be compared with the true infant mortality rate based on births. In the 1911 bulletin on "Mortality Statistics," the Bureau of the Census estimated on the basis of the figures quoted here and others, that the infant mortality rate per 1,000 births for the United States as a whole was about 124. Comparing this estimate with the computed rates for the foreign countries given in the preceding table, it will be seen that the rate of infant mortality in the United States is lower than in such countries as Chile, Hungary, Jamaica, Prussia, Servia, and Italy; about equal to the rate for the province of Ontario and for France; higher than the rate for England and Wales, Scotland, Finland, Switzerland, and Denmark; and considerably higher than the rate for Ireland, Sweden, Norway, New Zealand, and the Australian Commonwealth.

The figures quoted in the previous table also are of value in that they show the relative position of infant mortality in the different states and sections of the United States. The states included in the registration area are arranged in an ascending order according to their infant death rates. An examination of this table at once reveals the fact that in general the lowest rates are to be found in the Western and the highest in the Eastern states, with the rates for the North-Central (or Middle-Western) states in between. Thus, the

* Figures for deaths for 1911, first year of operation of state law.

average infant death rate for the 5 Western and Mountain states included was 91, for the 6 North-Central states, 108, and for the 9 New England and Middle-Atlantic states, 149.*

The same conclusion that in 1910 infant death rates were lowest in the Western part of the registration area and highest in the Eastern, with the Middle-West in between, is also to be drawn from an examination of the following table showing the infant death rate per 1,000 population under one year of age for the larger cities of the registration area:†

Oakland, Cal......	94.8	Dayton, Ohio.....	146.8
Seattle, Wash.	100.4	Cleveland, Ohio...	147.2
Portland, Ore.	105.3	Cincinnati, Ohio ..	149.8
Los Angeles, Cal...	110.7	Jersey City, N. J..	153.2
San Francisco, Cal.	113.6	New Orleans, La. .	154.9
Toledo, Ohio......	125.0	Atlanta, Ga.......	155.3
Cambridge, Mass..	126.1	Bridgeport, Conn..	155.5
St. Paul, Minn. ...	130.8	Philadelphia, Pa...	162.2
Birmingham, Ala..	133.0	Albany, N. Y.....	162.9
Louisville, Ky.....	134.0	Boston, Mass.....	165.5
Denver, Col.......	134.7	Worcester, Mass...	168.0
Grand Rapids, Mich.	134.8	Kansas City, Mo..	170.4
New Haven, Conn..	134.9	Milwaukee, Wis. ..	172.0
Nashville, Tenn....	135.1	Providence, R. I..	173.7
St. Louis, Mo......	135.8	Syracuse, N. Y. ...	176.4
Chicago, Ill.	139.5	Pittsburg, Pa.	179.6
Omaha, Neb......	140.0	Buffalo, N. Y.....	180.9
Columbus, Ohio...	140.4	Washington, D. C.	194.6
Spokane, Wash.....	142.4	Detroit, Mich.....	204.8
Indianapolis, Ind...	144.8	Baltimore, Md....	209.6
Newark, N. J.	145.8	Richmond, Va. ..	229.3
New York, N. Y...	146.2	Fall River, Mass..	259.5
Paterson, N. J.....	146.7	Lowell, Mass. ...	261.0

* As only 2 of the 16 Southern states were included in the registration area in 1910, no comparison of the incidence of infant mortality in this with other sections of the country is possible.

† Bureau of the Census: Bulletin 112— Mortality Statistics, p. 24.

The average infant death rate in 1910 per 1,000 population under one year of age was 115 for the 7 Western and Mountain cities included in the table, 149 for the 14 North-Central (or Middle-Western) cities, 165 for the 7 Southern cities, 162 for the 9 Middle-Atlantic cities, and 181 for the 8 New England cities.

This study of the position of infant mortality in the United States and foreign countries shows the seriousness and worldwide significance of the problem. It also shows how the infant mortality rate varies in different parts of the civilized world. Thus, the rate has been found to be much lower in Australia than in Europe. Among the European countries it was lowest in Norway, Sweden, Ireland, and Denmark and highest in Russia, Prussia, Hungary, and Italy. Turning to a single country, the United States, and substituting the use of the infant death rate per 1,000 population under one year of age for that of the infant mortality rate per 1,000 births, the same wide variation was revealed, the ratio of infant deaths to population being considerably less in the Western than in the Eastern parts of the registration area. Further examination of the tables also showed that the ratio varies just as widely when the cities of any state or country are compared. The examination of the report of the health department of almost any city that requires the registration of births and deaths will reveal the same variation by wards—and even by blocks, if figures are given for such small areas.

This wide variation in rates of infant mortality for different countries, states, and cities constitutes a fact of fundamental importance in the study of the subject. Out of it arise questions that at once bring us face to face with the relationship between social and industrial conditions and infant mortality. Why this wide variation in the geographic distribution of infant deaths? Why is the infant death rate lower in one country than another, in certain cities of the same country than others, in certain wards of one city than in others? Why, indeed, should the death rate for little children in the first year of life so far exceed the rate for older children and adults? All of these questions require for their answer some knowledge of the causes of infant mortality and their rela-

tion to industrial, domestic, and social conditions. But with this aspect of the problem this paper cannot deal.*

The Recent Decline of Infant Mortality in Foreign Countries. Since 1881, the first year for which statistics are available for most countries, there has been a noticeable decline in infant mortality in most foreign countries and cities and, since 1900, in most of the states and large cities included in the registration area of the United States. The following table shows this decline for the principal foreign countries for which statistics are available:

PER CENT. OF DECREASE IN THE INFANT MORTALITY RATE PER 1,000 BIRTHS FOR THE PRINCIPAL FOREIGN COUNTRIES FOR WHICH STATISTICS ARE AVAILABLE BETWEEN 1881-85 AND 1906-10. (a)

Country.	1881-1885.	1906-1910.	Per Cent. of Decrease.
EUROPE			
Hungary	250 (b)	204	18.4
Prussia	207	168	18.8
Italy	185 (b)	153	17.3
Servia	157	154	1.9
Belgium	156	141	9.6
France	167	126	24.6
England and Wales	139	117	15.8
The Netherlands	181	114	31.5
Switzerland	171	115	32.7
Finland	162	117	27.7
Sweden	116	78	32.8
Scotland	117	112	4.3
Denmark	135	108	20.0
Ireland	94	94	0.0
Norway	99	70	29.3
AUSTRALASIA:			
The Commonwealth	125	78	37.6
New Zealand	90	70	22.2

(a) Seventy Third and Seventy Fourth Annual Reports of the Registrar General for Births, Deaths, and Marriages in England and Wales (p. xciv and pp. 105-15 respectively).
(b) Figures for 1881-85 not available: those given are for 1891-95.

The rate of infant mortality for every country included in the table declined during this period of 30 years with the single exception of Ireland where, although the rate for both periods remained the same, it was at a very low point—94 deaths

* In other recent articles the writer has discussed this question of the relation of social conditions to infant mortality. See "Infant Mortality and the Size of the Family," QUARTERLY PUBLICATIONS OF THE AMERICAN STATISTICAL ASSOCIATION, September, 1915; "Infant Mortality and Urban, Housing, and Living Conditions," Journal of Sociologic Medicine, October 1915; "The Relation of Economic and Industrial Conditions to Infant Mortality," Quarterly Journal of Economics, November, 1915; and "The Influence of Prenatal Conditions on Infant Mortality," Proceedings of the Southern Sociological Congress, 1915.

per 1,000 births. The most notable decrease was in New Zealand and Australia. In the former the rate fell from the already low point of 90 deaths per 1,000 births to 70—a decrease of 22.2 per cent.—and in the latter from 125 to 78—a decrease of 37.6 per cent. The decline was also notable in Norway, Sweden, and Denmark and to a lesser extent in England and Wales. The absolute decrease was also great in Switzerland, the Netherlands, France, and Finland, but the rate was very high for each of these countries at the beginning of the period.*

The Registrar-general for England and Wales, from whose annual reports the preceding table was compiled, also gives figures showing the decline in the rate of infant mortality in the principal foreign cities since 1881–85. Space will not permit quotation of these in detail but the fact should be noted that in each of the cities included, with one exception (Trieste, Hungary), the rate of infant mortality declined during the period under consideration. The most notable decrease was in the three Dutch cities, Amsterdam, The Hague, and Rotterdam; the two Australian cities, Sydney and Melbourne; and the cities of Norway and Sweden, Stockholm and Christiania, in each of which the rate fell to a point below 100 deaths per 1,000 births—a record, as shown in the preceding table, also attained by each of the countries in which these cities are situated. The absolute decrease was also great in the two Prussian cities, Munich and Berlin, and the Hungarian city of Budapest, but the rate for each of these cities was very high at both the beginning and the end of the period.

The Decline in Infant Mortality in the United States. Unfortunately no series of infant mortality rates at all comparable with those just shown for foreign countries can be presented

* In view of the fact that, as has been frequently pointed out, the *apparent* decline in the rate of infant mortality in any country in a period of years may be affected by the increase in the per cent. of births which are registered, the figures given in the table may not in all cases be strictly comparable. For instance, if in three countries, in each of which the proportion of births registered in 1881 was 90 per cent., it should happen that the proportion registered should gradually increase in each *but unequally* so that in the first 92 per cent. of the births which occurred in 1910 were registered, and in the second 95 per cent., and in the third 99 per cent., the decline in the rate of infant mortality between these two years would not be strictly comparable unless the factor of varying perfection in birth registration were allowed for. This difficulty probably is not of sufficient importance to require its consideration here even if sufficient material bearing on the comparative efficiency of birth registration in foreign countries in the last thirty years were available.

for the United States. Figures are available, however, for Massachusetts and Boston for the same period, 1881–85, to 1906–10 and for three later years, 1911–13. Also, the per cent. of decrease in the infant death rate per 1,000 population under one year of age between 1900 and 1911 has been calculated by the Bureau of the Census for the registration area and the larger registration cities. The following table shows the decline in the infant mortality rate for Massachusetts and Boston since 1881 and the per cent. of decrease in the rate between 1881–85 and 1909–13:

PER CENT. OF DECREASE IN THE INFANT MORTALITY RATE PER 1,000 BIRTHS FOR THE COMMONWEALTH OF MASSACHUSETTS AND THE CITY OF BOSTON BETWEEN 1881-85 AND 1909-13. (a)

Years.	Massachusetts.	Boston.
1881-85	160	186
1886-90	161	178
1891-95	161	167
1896-1900	153	151
1901-05	138	138
1906-10	133	133
1909-13 (b)	121	120
Per cent. of decrease	24.4	35.5

(a) Compiled from the Massachusetts annual reports on births, deaths, and marriages and the annual reports of the Health Department of Boston.
(b) Figures for five year period are not available.

It will be noted that the infant mortality rate in this period of thirty-three years decreased over 24 per cent. in Massachusetts and about 36 per cent. in Boston. It will also be noted that the decrease was especially marked during the past few years.

The nearest approach to an accurate determination of the position of infant mortality in the other states and cities of the United States is to be found in a table recently presented by the Bureau of the Census, and herewith reproduced in part, which shows the per cent. of decrease in the infant death rate per 1,000 population under one year of age between the census year 1900 and the calendar year 1911 for the states and large cities of the registration area. It should be noted, however, that the rates given in this table are infant death rates calculated upon the basis of infant deaths to 1,000 population under one year of age and not according to the usual method of the ratio of deaths to 1,000 births.

PER CENT. OF DECREASE IN THE INFANT DEATH RATE PER 1,000 POPULATION UNDER 1 YEAR OF AGE BETWEEN THE CENSUS YEAR 1900 AND THE CALENDAR YEAR 1911 FOR THE STATES INCLUDED IN THE REGISTRATION AREA IN 1900 AND FOR CITIES OF 400,000 POPULATION OR OVER. (a)

Area.	Census Year: 1900.	Calendar Year: 1911.	Per Cent. of Decrease.
States included in the registration area in 1900 (b)	159.3	129.5	19
Rhode Island	197.9	138.6	30
Massachusetts	177.8	143 3	19
New Hampshire	172.0	150.3	13
New Jersey	167.4	131.5	21
New York	159.8	128.8	19
Connecticut	156.8	130.9	17
Maine	144.1	110.9	23
Vermont	122.1	102.0	16
Michigan	121.3	111.4	8
Cities of 400,000 population or over in 1910. (c)			
Baltimore	235.1	189.2	20
Philadelphia	201.9	141.9	30
Detroit	201.2	168.8	16
Boston	194.1	160.9	17
New York	189.4	130.6	31
Cleveland	185.5	123.7	33
Pittsburg	179.8	141.4	21
St. Louis	162.4	123.8	24
San Francisco	152.2	104.8	31
Buffalo	150.9	140.6	7
Chicago	146.6	123.3	16

(a) Twelfth Annual Report of the Bureau of the Census on Mortality Statistics for the year 1911, p. 24.
(b) Includes District of Columbia.
(c) Space does not permit the quoting of rates for smaller cities.

From this table it will be noted that in this period of 11 years the ratio of infant deaths to 1,000 population under one year of age decreased nearly one fifth (19 per cent.) in this group of registration states. The largest decrease shown in the rate for any of the states was in that for Rhode Island (30 per cent.) and the least in that for Michigan (8 per cent.). In all the cities included in the table the infant death rate also showed a decline—ranging from 33 per cent. in Cleveland to 7 per cent. in Buffalo. The fact that this comparison relates to only two individual years and that complete returns of deaths of infants under one year of age may not always have been made, coupled with the fact that the number of infant deaths per 1,000 population under one year of age does not furnish as satisfactory a basis for the study of infant mortality as the number of such deaths per 1,000 births, tends to diminish somewhat the value of the figures given in

the table. Yet, in spite of these limitations, these figures, taken in conjunction with those previously given for Massachusetts and Boston, show that in all probability there has been a marked reduction in infant mortality in this country in recent years.*

The Decline in the Infant Mortality Rate Compared with that in the Gereral Death Rate for All Ages. The extent of the decline in the mortality rate for infants under one year of age can not be fully appreciated until it is compared with the decline in the death rate for other age periods. The following table compares the decline in the infant mortality rate shown in preceding tables with the decline in the general death rate for all ages during the same periods:

PER CENT. OF DECREASE IN THE INFANT MORTALITY RATE PER 1,000 BIRTHS AND IN THE GENERAL DEATH RATE FOR OF ALL AGES PER 1,000 POPULATION BETWEEN 1881-85 AND 1891-95 AND BETWEEN 1896-1900 AND 1906-10, FOR THE PRINCIPAL FOREIGN COUNTRIES. (a)

Country.	Per Cent. of Decrease Between 1881-85 and 1891-95		Per Cent. of Decrease Between 1896-1900 and 1906-10	
	General Death Rate.	Infant Mortality Rate.	General Death Rate.	Infant Mortality Rate.
Hungary	3.9	—	10.4	6.8
Prussia	10.2	1 0	17 6	16.4
Italy	6.6	—	8.3	8.9
Servia	+15.2	+8.7	+35.6	3.1
Belgium	2.4	+4.9	+26.7	10.8
France	+0.4	+2.3	7.2	20.8
England and Wales	3.6	+7.9	16.9	25.0
The Netherlands	8.4	8.8	16.8	24.5
Switzerland	7.0	9 3	+30.4	19.6
Finland	7.7	10 5	8.4	15.8
Sweden	5.1	11.2	11.2	22.8
Scotland	3.1	+7.1	10.6	13.2
Denmark	+1.1	+2.2	16.5	18.2
Ireland	+2.7	+7.8	4 4	11.3
Norway	2.3	1.0	11.5	27.1
New Zealand	7.3	3 3	+1.0	12.5
The Australian Commonwealth	15.3	12.8	15.7	30.4

A plus sign (+) denotes an increase.

(a) Compiled from the Seventy Third and Seventy Fourth Annual Reports of the Registrar General for Births, Deaths, and Marriages in England and Wales for the years 1910 and 1911. The Twelfth Annual Report of the Bureau of the Census on Mortality Statistics for 1911 quotes in detail the general death rates from which the per cents. of decrease in this table were compiled.

* This is the conclusion arrived at in the Twelfth Annual Report of the Bureau of the Census on Mortality Statistics for the year 1911, p. 24, and expressed in the following words: "There has been a marked reduction in the infant death rate in recent years."

The first thing to be noted upon examination of the above table is the much greater per cent. of decrease in both the general death rate and the infant mortality rate in the last than in the first half of this period of thirty years. Thus, from 1881–85 to 1891–95 the infant mortality rate decreased in only 8 of the 15 countries for which rates could be obtained, while from 1896–1900 to 1906–10 it declined in every country included in the table. Moreover, the average per cent. of decrease for all countries in the latter period was twice as great as in the former. The same variation is also shown in the decline of the general death rate in the two periods but to a somewhat lesser extent.

By comparing the extent of the decline in the infant mortality rate with that in the general death rate it will be seen that in the first half of the period the greater decline occurred in the general death rate, while during the second half the greater decline occurred in the infant mortality rate. Thus, from 1881–85 to 1891–95, a greater per cent. of decrease in the infant mortality rate occurred in only 4 of the countries included in the table, while from 1896–1900 to 1906–10 a greater per cent. of decrease failed to occur in only 2 countries.

A similar comparison extending over the same periods can be made for Massachusetts, and it shows the same results. Thus, from 1881–85 to 1891–95, the general death rate for Massachusetts decreased 0.5 per cent. and the infant mortality rate increased 0.6 per cent., while during the period from 1896–1900 to 1906–10 the former rate decreased 10.5 per cent. and the latter 13.1 per cent.

That this greater decline in the infant mortality rate than in the general death rate during recent years is probably typical for this country is shown in the following table, which compares the per cent. of decrease between 1900 and 1911 in the general death rate and the infant death rate for the states included in the registration area in 1900:

PER CENT. OF DECREASE IN THE INFANT DEATH RATE PER 1,000 POPULATION UNDER 1 YEAR OF AGE AND THE GENERAL DEATH RATE FOR ALL AGES PER 1,000 POPULATION BETWEEN 1900 AND 1911, FOR THE STATES INCLUDED IN THE REGISTRATION AREA IN 1900. (a)

State.	General Death Rate.	Infant Mortality Rate.
All States (b)	14	19
Rhode Island	25	30
Maine	13	23
New Jersey	17	21
New York	14	19
Massachusetts	17	19
Connecticut	15	17
Vermont	9	16
New Hampshire	13	13
Michigan	11	8

(a) Twelfth Annual Report of the Bureau of the Census on Mortality Statistics for the year 1911, pp. 22 and 25. The general death rates are "corrected on the basis of the standard million of England and Wales."

(b) District of Columbia included in both rates and Indiana in the general death rate in addition to the states mentioned.

During this period of 11 years a greater decline in the infant death rate than the general death rate for all ages occurred in all of the 9 states included in the above table except 2, New Hampshire and Michigan. In the former the decline in the two rates was exactly equal. All evidence seems to point, therefore, to the conclusion that the decline in the infant mortality rate during the last 10 or 15 years has been greater than that in the general death rate for all ages.

Before leaving this subject it will be advisable to compare the decline in mortality by age. This is possible from the figures given in the following table comparing the per cent. of decrease in the death rate for persons of different ages between 1900 and 1911 for the group of registration states as constituted in 1900:

PER CENT. OF DECREASE IN THE DEATH RATE PER 1,000 POPULATION FOR CERTAIN AGE GROUPS BETWEEN 1900 AND 1911, FOR THE STATES INCLUDED IN THE REGISTRATION AREA IN 1900. (a)

All ages	13		
Under 1 year	22	25 to 34 years	23
1 to 4 years	35	35 to 44 years	9
5 to 9 years	32	45 to 54 years	3
10 to 14 years	27	55 to 64 years	+4
15 to 19 years	27	65 to 74 years	+3
20 to 24 years	26	75 years and over	0

A plus sign (+) denotes an increase.
(a) Twelfth Annual Report of the Bureau of the Census on Mortality Statistics, p. 22.

An examination of these figures shows that the death rate for all age groups under 55 decreased between 1900 and 1911. The greatest decrease was for the age group 1 to 4 years, the per cent. of decrease falling off with each succeeding age group until the period from 55 to 64 years was reached, this and the next group showing a small increase. The death rate above 75 years was practically the same in each period. The per cent. of decrease in the mortality of the first year of life was noteworthy (22) but it was exceeded by that of the years of both childhood and adolescence, being about equal to that for the age group 25 to 34 years and greater than that for all succeeding groups.

It has thus been shown that since 1881 the rate of infant mortality has been declining in practically all European countries for which statistics are available, in the Australian Commonwealth and New Zealand, and in Massachusetts and Boston in this country. This decline in infant mortality has been especially marked in the last twelve or fifteen years during which period it has practically everywhere exceeded the decline in the general death rate for all ages. It has also been shown that between 1900 and 1911 a marked decline in the infant death rate per 1,000 population under one year of age occurred in the states and large cities of the registration area. Here, too, the decline in the infant death rate was with one or two exceptions found to be greater than that in the general death rate. On comparing the per cent. of decrease in the death rate for infants under one year of age with that for other ages it was found that the decline in infant mortality was less than that for children or young persons under 25 years of age but about equal to that for persons in the age group 25 to 35 years and greater than that for persons over 35. It appears, therefore, that the decline in the infant death rate has in general been greater than the decline in the adult death rate; but the decline in the infant death rate has not been as great as the decline in the death rate for persons in the years of childhood and adolescence.

REVIEWS AND NOTES.

NOTE.

A Division of Statistical Research was organized in the New York City Health Department within the Bureau of Records on June 1, 1915 The creation of such a division has long been contemplated by the Department and repeatedly recommended by special committees.

It is hoped that the new division will justify its existence from the start and thus secure a reasonable amount of support in the next budget. The new division hopes to take over the statistical work of the different bureaus of the department and in this way to secure a saving of labor that can be devoted to the development of the department's statistics. The division will then be able to supply the bureaus of the department with scientific data to guide them in their different fields of health work.

The new division has been organized entirely without additional cost to the city by detailing qualified workers from within the department. Shirley W. Wynne, M.D., Assistant Registrar, Manhattan, has been designated Chief of the new division.

L. I. D.

STATISTICS OF SUICIDE IN SPAIN AND SAXONY.

Under the caption, "*Zur Statistik des Selbstmords,*" the *Deutsches Statistisches Zentralblatt** discusses recent publications on suicide statistics in Spain and in the Kingdom of Saxony.

Spanish suicide statistics, in spite of their detail of presentation, have hitherto obtained but little notice. They were formerly grouped with the general statistics of mortality, but were made the subject of special enumeration by a royal decree of September 8, 1906. As suicide still entails certain legal consequences in Spain, the lower courts were entrusted with the filling out of a questionnaire for every suicide and attempted suicide, and were instructed to send these questionnaires, at the end of every quarter, to the Geographical and Statistical Institute for compilation. These forms do not contain the names of suicides. They record nationality, home, temporary or permanent character of stay in locality, literacy, manner of committing suicide (9 titles), and cause of suicide (13 titles).

The first comprehensive compilation for Spain has appeared under the title, "*Estadistica de Suicidio en España*" (Madrid, 1913) for 1906–1911. It analyzes the material by years, provinces and large cities, age, conjugal condition, time of suicide, etc. Of course the criminal nature of the act in Spain is certain to have made the figures too low. The tables are accompanied by comparisons with other European countries. It appears that, during the period of observation, there were 74 suicides and attempted

* Vol. II, No. 1. Leipsig, January, 1915.

suicides per million population. It is noteworthy that these cases occurred, for the most part, among persons of the higher cultural grades.

Suicides occurring in Saxony since 1830 are discussed by Dr. Georg Radestock in the *Zeitschrift des Königlichen Sächsischen Statistischen Landesamtes*, 1913, No. 2, p. 275 ff. He depicts the evolution of suicide statistics and of the methods of enumerating them. Reliable data are obtained by means of a comparison of police reports with registry office mortality records. Of course a certain percentage of false reports by physicians must be reckoned with.

In the recent figures it may be pointed out that suicide is the second cause of death, with respect to frequency, among men aged 15–29; it is exceeded only by tuberculosis. It is third in order of frequency among men aged 30–39. It is almost twice as frequent at ages 30–59 as at ages 15–29. If these figures are accurate, then the incidence of suicide in Saxony is much higher than it is in the Registration Area of the United States, where suicide ranks seventh in the list of causes of death among males in age period 15–29 and sixth in age period 30–39. In the Industrial mortality experience of the Metropolitan Life Insurance Company, suicide in the first age period ranks eighth and in the second age period ranks fifth.

The author points out that city dwellers usually seek rural surroundings to commit suicide, and discusses the influence of the time of day and of the day of the week; Saxony is perhaps unique in studying the bearing of these factors upon the question. In 1911 most of the suicides occurred on Saturday, in contrast to the predominant occurrence of fatal accidents on Monday. Enumeration by occupation brought interesting results. Analysis by religious confession was incomplete, but steps are being taken to remedy this defect.

O. Kürten has treated the same subject in "*Statistik des Selbstmordes im Königreich Sachsen,*" appearing as Supplement No. 3 of the *Deutsches Statistisches Zentralblatt.* He devotes himself rather to the general bearings of the subject than to its many detailed aspects. Among the interesting points, however, which he brings to light, is the fact that suicide attains its greatest frequency, not in large cities, but in towns of 16,000–25,000 inhabitants. He is skeptical with regard to studies of the correlation of suicide with criminality, food-prices, economic and political crises, etc.

LOUIS I. DUBLIN.

Manual for Health Officers. By J. Scott MacNutt. Published by John Wiley and Sons, New York, 1915. Cloth, $3.00.

This volume is a useful addition to the equipment of American public health officials. The author is to be congratulated on a work which so completely puts at the disposal of health workers the best thought and practise in their important field. The point of view is at once comprehensive and radical, as might be expected from Mr. MacNutt whose admin-

istration as health officer of Orange, New Jersey, attracted wide attention. It is the newer public health that is emphasized; the public health which embraces not only the best medical practise but includes the essentials of sanitary engineering and social science as well. The author's association with Professor Sedgwick and his school is a guarantee of an authoritative and progressive treatment of the subject.

Part I contains four useful chapters which outline the historical development of the public health movement in America, local, state, and federal. The general scope of the new public health work is clearly outlined.

Part II, the rest of the volume, gives a detailed treatment of the daily routine of the health officer in his control of the communicable diseases; considers such important matters as child hygiene, the milk and water supplies of communities, housing and industrial hygiene, and the question of nuisances. All of these problems are considered in the light of the most authoritative practise in America and abroad.

To the readers of this QUARTERLY, the most interesting sections of the volume will be those which treat of vital statistics. In general, it may be said that the author appreciates the value of vital statistics as an aid to public health work. He places emphasis in every chapter on the need of good vital statistics as a proper basis for scientific health administration, whether it be in the control of the communicable diseases or of infant mortality or of the housing problem. In addition, an entire chapter, IX, is given to the subject of vital statistics. This is a skillful although a non-technical treatment of a difficult subject. An exposition is given of the underlying principles of statistics, their purposes and uses and the chief sources of error in their interpretation. But more important are the hints, which are in large measure the result of the author's own experience as a health officer, to guide others through the many difficulties involved in the registration of vital statistics, especially of births and deaths. Excellent instructions are given for the preparation of statistical tables and of the annual health report in accordance with the rules of statistical practise approved by the Section on Vital Statistics of the American Public Health Association. The value of the chapter would have been enhanced, however, by the inclusion of the model tables recommended by Committees of the Section.

This book has already found its place in the literature of American public health work and will grow in usefulness as the movement demanding full-time, well-trained, health officers is extended throughout the country.

LOUIS I. DUBLIN.

Elements of Record Keeping for Child Helping Organizations. By Georgia G. Ralph. New York Survey Associates, 1915. Pp. XII+195.

One who has had any connection with an organization engaged in social work knows that success cannot be attained without good case work. Proper investigation must be supplemented by adequate records. The personnel of an office force is constantly changing and memory is faulty.

It is all too often the case that a conscientious worker connected with an organization for years is suddenly removed and unless the records are in good shape the past becomes more or less a myth. The Russell Sage Foundation deserves the thanks of child helping organizations in this country in that it has made possible the preparation and publication of this volume. If the superintendents of children's institutions would read this volume carefully and profit by it, there would be a big change in the character of their annual reports. There is, of course, a limit beyond which it is impossible for an organization to go in multiplying records, but no organization is justified in caring for children unless they have some record showing the antecedents of the children, their physical and mental condition when received, their history while in the institution, and a record of them since they were placed out. Some of the blanks proposed seem unduly elaborate, but when one sits down to decide what question could be omitted without detracting from the value of the records, he is troubled to make a start. Not only are forms suggested for proper record keeping but cards in present use by a large number of different organizations are included in the volume.

For many workers perhaps the two most valuable chapters are those on methods and devices for making records available and on abstracting the material for annual reports. Many social workers, besides those engaged with children, could read these two chapters with profit. A short bibliography is included and the volume is well indexed. One would receive the impression from reading this volume that the author had not only made a careful theoretical study of the field, but had been confronted with some of the problems through actual work.

WILLIAM B. BAILEY.

"*Statistics Relating to Crime in Chicago.*" By Edith Abbott, Ph.D. 88 pp. Reprinted from Report of a City Council on Crime of the City of Chicago. Chicago School of Civics and Philanthropy, 1915.

In this statistical study of crime in Chicago, Dr. Abbott had done a good piece of work. The figures had to be collected from four different sources and when all the available material was collected the data were still lacking for a complete study of the social status of the offenders. The report is divided into two parts: the first covering the statistics of arrest and trial of offenders, and the second their social condition. There are altogether thirty-nine statistical tables besides a considerable number included in the eight appendices. These tables are well planned and give both absolute numbers and percentages in almost every case. In addition to the tables and accompanying text, there are two general summaries giving the main lessons to be gained from a study of the statistical tables. It is apparent that over one half of the persons brought before the courts of Chicago are discharged without conviction. The waste from such a large number of unnecessary arrests is apparent. Only about 3 per cent. of the total number of persons arrested are sentenced to prison. Out of 109,711 persons arrested in 1913, 2,076 were sentenced to the County Jail

or House of Correction and 2,182 were held for the grand jury. Over 80 per cent. of the commitments to the House of Correction were for non-payment of fines. About 60 per cent. of the persons arrested are under 30 years of age. A careful study of the statistics seems to show that the foreign born population is no more criminal than the native born when proper weight is given to the differences in sex and age distribution.

It is to be hoped that this careful study of criminal statistics in Chicago by Dr. Abbott will lead to the publication by that city of a series of annual reports which will render unnecessary another study of this nature.

W. B. B.

Negro Year Book—An Annual Encyclopedia of the Negro, 1914–1915. By Monroe N. Work, 443 pages. 35 cents. Negro Year Book Publishing Company, Tuskegee Institute, Alabama.

The Negro Year Book for the period 1914–1915 fills the need for a comprehensive presentation of facts about the interests and progress of the negro race in America. It is a permanent record of the essential historical facts relating to negro population, health, religious affiliation, education, biography and social organization. The extensive bibliography at the end of the volume should be especially useful. Mr. Work is to be commended for having brought together such a convenient and useful collection of data.

E. W. Kopf.

Publications of the American Statistical Association.

The New Series of the Association, issued quarterly, will be sent to members of the Association on payment of the annual dues of two dollars. The subscription price is also two dollars per annum. Separate copies can also be purchased upon remittance of the advertised prices.

The following list of titles includes only the most important papers published in the several issues. There is in addition a considerable amount of miscellaneous material.

VOL. I. 1888–1889. Nos. 1–8. Pp. 492. PRICE $4.00.

No. 1. Statistics of Water Power Employed in Manufacturing in the United States. GEORGE F. SWAIN. 75 cents.

Nos. 2, 3. Park Areas and Open-Air Spaces in American Cities. E. R. L. GOULD.
Key to the Publications of the United States Census, 1790–1788; with Occasional References to Other Statistical Works. EDWARD CLARK LUNT. $1.00.

No. 4. Life Insurance in the United States. WALTER C. WRIGHT. $1.00.

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Statistics of Divorce in the United States and Europe. SAMUEL W. DIKE. 50 cents.

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Statistics of Municipal Finance. HENRY B. GARDNER. 75 cents.

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No. 8. Finance Statistics of the American Commonwealths. EDWIN R. A. SELIGMAN.
Divorce in France. BENJAMIN F. KELLER.
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VOL. II. 1890–1891. Nos. 9–16. Pp. 470. PRICE $4.00.

No. 9. Mortgage Statistics. GEORGE K. HOLMES. 50 cents.

No. 10. The Study of Statistics in Italian Universities. CARROLL D. WRIGHT.
Statistics of Private Corporations. ROLAND P. FALKNER. 50 cents.

Nos. 11, 12. Statistics of the Colored Race in the United States. FRANCIS A. WALKER.
How to Make Statistics Popular. CHARLES F. PIDGIN.
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No. 15. **The Eleventh Census.** R. P. PORTER.
Criminal Statistics. ROLAND P. FALKNER. 75 cents.

No. 16. **The Census Enumeration in Prussia.** CARL C. PLEHN.
A Plea for the Average. GEORGE K. HOLMES. 75 cents.

VOL. III. 1892–1893. Nos. 17–24. Pp. 614. PRICE $4.00.

No. 17. **Statistics of Crime in Massachusetts.** FRED G. PETTIGROVE.
Development of Statistics of Religions. M. FOURNIER DE FLAIX. TRANSLATED BY ALICE R. JACKSON.
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